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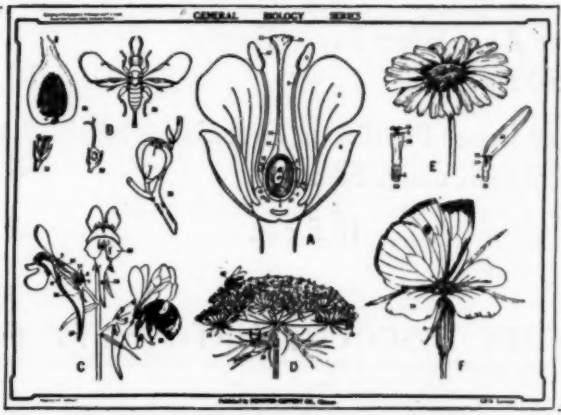

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INDIAN INDEPENDENCE DAY

THE FIFTEENTH OF AUGUST is of momentous importance in the national struggle for Independence of India. In the history of the world the day is of unique significance. For, unlike America and Ireland which achieved their independence through war and bloodshed, India has won her freedom through peaceful and yet more compelling self-travail. All thanks to MAHATMA GANDHI and the Spirit of the East, a new weapon worthy of civilised humanity has been forged for resolving conflicts between great nations. From this day onwards India attains her due status in the Councils of the world. We have reason to hope that her persuasive voice of Justice will quench for all time the threat of war among men.

For India herself, the fifteenth of August will always remain a day of prayer, and grateful remembrance of all the martyrs who struggled and laid down their lives for the righteous cause of liberation of India and all oppressed humanity. This will ever be a day of new hopes and of dedication to new efforts.

With a National Government installed in Delhi, Science enters on a new phase of development. As PANDIT NEHRU has rightly said, science alone can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom, of a rich country allowing its people to starve. If we are to come up on a level with sister states in the world, speedy progress is to be achieved both in basic and applied sciences. We assure our National Leaders that the enthusiastic co-operation of scientists is at the service of the Nation in building up an India worthy of the long-cherished dreams of her children. With the advent of freedom so much that seemed impossible only a year ago is now easy of achievement that we might not be considered too optimistic if we prophesy that the era has begun for India of peace and prosperity through scientific progress.

TRAINING OF POWER ENGINEERS IN INDIA

INDIA IS INDEPENDENT. In the wake of her independence will follow her industrial development and expansion. For the industrial expansion of India the Electric Power Development must receive its due importance. This importance has been acknowledged by the Government of India. In India's power development the training of Engineering personnel is undoubtedly one of the most important things that the country has to concern itself with. Hand in hand with the electric power development programme, provision must also be made for the training of the Power Engineers, for without trained personnel the great plans now under contemplation cannot mature. We are planning to increase the electrical generating capacity of India. It is planned to increase this by approximately four million kilowatts in the next five or six years. Only this small increase will involve more than trebling the number of her Electrical Engineers. With the enormous potentialities of development in this field existing in this country, an ever-increasing number of engineers will be essential. With the electrification, as existing industries grow and new industries are established, bigger demands for the engineering personnel will arise. Urgent and immediate attention, therefore, is to be given to the training of Power Engineers for our power developments, without whom our plans will not be possible.

The position of India in this connection is the same as what existed in Russia and Japan when they embarked on their electrical power development. Their first efforts were to train a large body of technical personnel. Now that we are moving to take measures in the development of our power resources, our first consideration should be directed towards the creation of technical personnel with specialised knowledge in this field. India must depend on her own nationals for specialists. Foreign help, which we might and would need at this stage, should only be the initial makeshift. To import foreign help would also be a costly affair as whatever can be obtained from other countries would only be by attractive remuneration, and/or by foreign interests. A number of foreign experts have been invited. In the initial stages, we might have to invite them in a larger number. A number of our young Engineers are also sent abroad for training. These young men, when they return, would form a nucleus of technical personnel, but a very small one. Again, the facilities for training accorded to our young engineers, whom we have sent abroad, are not what they should be. Numerous and repeated complaints are received from them. It has to be acknowledged that co-operation at this stage of the industrially advanced countries for the training of our students has to be sought. It is hoped that friendly gesture will arise. This, however, is not the aim. We must arrange to train our personnel ourselves; for a number of years engineering personnel will be required in large numbers in India. For the electrical development of India there is an immediate need of properly trained engineers with training in Power Engineering at a higher level than is now given in our Engineering and Technical Colleges. With the rapid increase in the electrical generating capacity in the country, unless proper trained engineers are soon available, it might easily create a main bottle-neck.

To this purpose, the authorities of the Indian Institute of Science prepared and sponsored a scheme for training of Power Engineers. This received the blessings of the Government of India. Thus came into being the Power Engineering Department at the Indian Institute of Science. This department will form a training centre for Power Engineers. In this department will be admitted engineering graduates from the Indian Universities. The course would be a post-graduate one of two years duration. The object of the course is to provide instructions in Power Engineering (Hydro and Thermal) so that the product of this course, after this training, immediately presents material for superior positions and fill them and discharge them with confidence. The graduates in Engineering in India when they emerge from their college courses do not possess sufficient knowledge and experience of power engineering, either in planning or operation. Adequate facilities do not exist in this country. The training proposed for the Power Engineers is to provide a training ground in India, which other countries like the U.K. and the U.S.A. have. The post-graduate power engineering department is, therefore, created for imparting specialised

training in power engineering to selected civil, electrical and mechanical engineering graduates, for producing adequately qualified engineers for power development, for electric supply industry, and also for large industrial undertakings having their own generation plant and/or electrical equipment.

The course will be divided into 3 sections of Power Engineering, Civil, Electrical and Mechanical. Civil engineering graduates will specialise in civil work of Hydro-Electric installations, Mechanical engineering grduates in Thermal Power Stations, Boiler House and Boiler House Economics, Fuel Research, and the Electrical engineering graduates in Electric power generation, transmission and distribution of power and its utilization. The theoretical training imparted to the young graduates will be of an advanced nature and so arranged as not to overlap or be of the same order or standard as the theoretical training which they have had in their Engineering Colleges. The students specialising in one of the above three branches will receive ancillary training in the relevant portions of certain subjects common to all the three branches which are considered essential for the proper all-round training of Power Engineers. Besides this, the training will also include preperation of co-ordinated designs and drawings and typical co-ordinated power projects.

The course will be divided into two periods of one year each. One year for the theoretical training on the above lines and one year in practical experience in their specialised subjects. Apart from an intensive course of training in the well-equipped laboratories and other plants of the Power Engineering Department (which will coincide with the theoretical training period), in the second year, outside practical training facilities will be arranged for the students with large private electricity supply undertakings, provincial authorities, and in other Government planned projects under construction. For professional engineers no such national training scheme exists. Nor is it realised generally that the degree of responsibility hitherto shown by the employer towards an apprentice trainee is almost nil. A number of cases exist where apprenticeship is exploited as a means of cheap labour confined in narrow limits and limited sections of the engineering works where they are sent. It is here that assistance will be sought from the Government to ensure and take such steps that, in the practical training and experience of these students, necessary facilities and latitude on a wider margin than hitherto acknowledged, will be given.

Considerable thought and importance has been given to laboratories, their equipment, and other plant. These consist of a well-equipped Thermal Power Station, Electrical Laboratory, Hydraulics and Hydro-dynamics Laboratory, Materials Testing Laboratory, Electrical and Mechanical Workshops, and a High Voltage Engineering and Research Laboratory. The Thermal Power Station will form the centre for providing the practical training. It will be equipped on modern lines and with reasonably adequate plant. The equipment in Hydraulics and Hydro-dynamics Laboratory will also provide means for special tests and research work on different problems. Materials Testing and Electrical and Mechanical Workshops will serve their own useful purposes. In the Electrical Laboratories is included an A.C. Network Calculator. This Calculator will be made available to other large electricity undertakings and Central Technical and Provincial Power Boards to solve their problems. This equipment will solve problems such as finding out fault currents at any point in a complicated and interconnected power system, best position for any new generating station and its installation, interference with communication lines, etc. The High Voltage Engineering and Research Laboratory forms a section of the Power Engineering Department. The equipment in this laboratory will be capable of producing a three million volt surge, one hundred thousand amperes current surges, and a million volt A.C. power testing.

The High Voltage Laboratory will serve needs for research, in special power problems, experimental work for transmission lines, and closely associate itself and render assistance to such allied subjects and industries. Arranged and co-ordinated with the power plant and the high voltage laboratory, there will be erected a length of overhead E.H.T. transmission line. Apart from the routine testing and operational work on this line, it would be used for experimental and research work for any special problems of the transmission line designers and engineers in India. In the

Power Engineering Department importance will be attached to research work. There is very small amount of engineering research being conducted in the Universities and Technical Colleges in India. Research would be made a prominent feature, and it should help the student to appreciate the attitude and technique of science in seeking to enlarge the realm of scientific knowledge and this attitude he must have if he is to be a creative Engineer.

The intentions also are to arrange and invite specialists and acknowledged experts in various branches of electrical engineering in particular reference to power generation and development, to give a course of lectures in their specialised spheres and problems. It is here that another course could profitably be arranged. A course of short duration for Professional Engineers which would serve as a Refresher Course, would be provided. The experts, who would be invited, will not be restricted only to this country but from other countries of the world—U.K., U.S.A., Russia and others. These experts would discourse on special problems which confronted them, the methods they adopted to get over their difficulties, and discuss with our engineers problems that might be confronting us and suggest from the light of their experiences possible remedies and solutions. With the birth of this new training scheme at the Indian Institute of Science, let us hope, would be born similar and many other scientific and technical training and research centres, and India would produce within herself her own Scientific and Technical Personnel, second to none.

M. S. THACKER.

INDUSTRIALISATION OF THE INDIAN CONTINENT*

SANKALCHAND G. SHAH

THE geographic distribution of India's natural resources makes it clear that industrial and economic planning of the country should be a subject of the Federal Centre. In order to achieve a progressive economy a Central Planning Commission should be appointed immediately, as the A.-I.M.O. has already recommended, to evolve a 'single cohesive plan for the whole country by integrating all regional plans in close association with all Provincial Governments, States, and industrial organizations'.

The United Nations' Far Eastern Group, in a report issued by them, lists the following as the main obstacles which retard economic reconstruction in the Far East—political and social unsettlement; training and education of personnel; provision of capital; foreign exchange resources; equipment and materials; monetary disorders and inflation; basic consumer goods and services; and application of technology and research. I may say that these obstacles exist in this country also.

The industrial activity of India has increased only by about 15 per cent. during the last ten to twelve years. Russia by a determined planning of industries has increased its *per capita* income by 3½ times in ten years as a result of investing 4,700 crores of rupees in industries and 1,860 crores in transportation from the savings of the people. The *Bombay Plan* suggested that in fifteen years we could increase our national income by three times and double our *per capita* income by investing 3,475 crores in industries and 1,300 crores in transportation.

FIVE-YEAR PLANNING ADVOCATED BY SIR M. VISVESVARAYA

Sir M. Visvesvaraya pleaded at the last Annual Conference that an annual investment of Rs. 300 to Rs. 500 crores should be sunk into new industrial enterprises *in the next five years* if the Industrial development of this country is to be a *fait accompli*.

This advice of our veteran President—himself one of the greatest industrialists of India—must be acted upon in time, as by further indecision and theorising, valuable time will be lost, losing a start, that would enable Indian industries to brace themselves to meet foreign competition. Enough of "Paper Planning": we want concrete action.

FOREIGN CAPITAL AND JOINT VENTURES

I have stressed already the urgent need for the rapid industrialization and also the early necessity for planning the same. The

* Text of the Address by Mr. Sankalchand G. Shah to the All-India Manufacturers' Organization, 20th July 1947 at Bombay.

question now naturally arises, "Is sufficient capital available in the country to meet the needs of our industrial development?" I submit this is a matter of utmost importance to the country as a whole and should be tackled forthwith.

I believe there is not sufficient capital in the country for any large-scale promotion of heavy and key industries. There is a fairly large amount of hoarded wealth in the country. I am of the opinion that for some years to come at least the general public will hesitate to invest their capital readily in new ventures as we lack technical experience and the "know-how" of production at present. Confidence could be created in the public if foreign technical co-operation can be secured. It is, therefore, essential to invite both foreign capital and technical co-operation for starting heavy and key industries in India at least during the next few years. While it may be preferable to obtain foreign capital mainly in the form of loan, I am of the opinion that it will be more advantageous to start joint ventures with the co-operation of foreign industrialists. This question of Joint Ventures was personally discussed by me with many foreign industrial and business leaders while I was abroad recently as a member of the A.-I.M.O. Delegation. Most of them agreed that in all such joint enterprises the controlling interest should be predominantly Indian and that management also should be entirely in Indian hands. The share capital to be supplied by Indian industrialists and the foreigners may be, say in the ratio of 60 : 40 or thereabouts. The foreigner would subscribe his share of capital in the form of capital goods, machinery, services and supply of technical information. The Indian industrialist would subscribe his share in the form of buildings, labour, management, working capital, etc.

State and Private Enterprise

There is, however, one obstacle in this connection. There is a growing suspicion in the mind of many foreign industrialists and technicians that the National Government of India may nationalise large-scale industries in the course of the next few years. This suspicion may be baseless, but it is there, and early steps should be taken by the Government to remove it. I do not propose to go into detail on this question of relation between State and private enterprise as it was fully discussed at our last Annual Conference at Delhi. I welcome in this connection the Hon'ble Pandit Jawaharlal Nehru's statement: "In the present stage there will have to be inevitably a great deal of private enterprise. I do not want to interfere with them. But if you are going to plan, even these private enterprises must function within that plan."

German Experts

I now turn to the very important subject of securing first-rate experts for starting and running our industries. As a result of my personal investigations while abroad, I am of the opinion that it would be highly advantageous for us to have experts from Germany. Experts from other countries such as the U.K., U.S.A., or Continental Countries are not generally available due to the demand in their own countries for post-war reconstruction, or even if available, can be secured only on very high salaries. Further many of them will not like to stay in India for any length of time and will at least like to return to their country at intervals, and this will naturally prove very costly. In the case of German experts they are willing to leave their country and settle in India, as the future of Germany is more or less sealed at least for the coming twenty to thirty years, and as they are not hopeful of their future in their own country. I, therefore, urge that it be taken up with the Government of India immediately, and that they be moved to secure for industrialists the services of the best available technical experts from Germany.

Capital Equipment

I would also like to refer in this connection to the question of obtaining capital equipment for our industries. We have pressed the Government of India on so many occasions that there should be the fewest possible restrictions on the import of capital goods from abroad. Partly as a result of this agitation, I am glad to observe that the Government of India have revised their import policy. In their Press Note, dated 16th May 1947, they have announced that licences for importing a number of types of machinery and certain essential raw materials will be granted freely. While I welcome this, I regret to note that automatic revalidation of licences, which expired on the 30th June 1947, has not been permitted in the case of capital goods, though the same has been done in the case of a number of other articles. I find no valid reason for this

discrimination and, therefore, urge upon the Government of India to remove it forthwith. As regards obtaining capital goods, I would like to make a suggestion. Till now the country has been looking forward to the U.K. and the U.S.A. mainly for obtaining its requirements of capital goods. There are good prospects for obtaining the same from Continental countries such as Sweden, Switzerland, France, Belgium, Czechoslovakia and others, and I would like to urge that they be explored and availed of immediately. Furthermore every effort should be made for obtaining India's share of reparations from Japan mainly in the form of capital goods. Before I conclude this subject of capital goods, I would like to stress that special attention should be paid to the local manufacture of machinery with the aid of foreign experts where necessary. In the beginning the quality of such machinery may not be high or quite up to the standard, but with the passage of time and with Government's support and encouragement it is bound to improve.

Taxation

I now pass on to the subject of Taxation. At present the Indian industries are subject to an intolerable burden of taxes. If this continues, I do not know from where will Companies and individuals get money to build, equip or expand their activities. I, therefore, submit that the present severe rates of taxation should be revised and reduced, and part of the money now flowing to the Government Treasuries from industries should be diverted to its most fruitful and productive channel, *viz.*, the development and maintenance of industrial enterprises. This step is necessary if Indian industries are to carry on successfully in the future when more competitive conditions will prevail and also to undertake the expansion which is contemplated under various post-war industrial expansion schemes. I would like to make a suggestion in this connection. During the course of discussions in the Central Legislative Assembly, the Hon'ble the Finance Member assured that a Committee of Experts would be set up to examine the provisions of the Income Tax and E.P.T. (Amendment) Act, 1947, and to make recommendations to Government to remove the difficulties in the Act and to suggest how Government could make it more effective and easy to administer. This Committee has not so far been set up by the Government, and I urge that it be done without any further delay and that representatives of Industrial Organizations like ours should be included in the same.

Research

Another important problem facing the Indian industries is that of provision for industrial research. Under the urgent and pressing needs of War, new types of machines and materials which were not dreamt of formerly have been discovered. Progress in industrial research is vital to India. Our country has vast and varied resources of wealth, but they will be useful only if they are made to serve industrial needs. I am glad to note that our National Government is alive to this desideratum. Provision has already been made for starting a number of research laboratories in the various parts of the country, and I am confident that we may expect further progress in this line in future.

Import-Export Controls

I have often criticised in the past our Government's import-export control policy which hampered the growth of indigenous industries. I have also urged that the best possible use of India's foreign exchange resources should be made by restricting the import of some consumer and non-essential goods. In the Press Note on Import Trade Control issued by the Government on the 16th May 1947, I notice with satisfaction that there has now been a marked change in Government's policy. It has been announced that no licences would be granted for about 350 items. Another welcome announcement already referred to is that henceforth licences for import of capital goods, machinery, and certain essential raw materials will be granted freely.

Labour-Management Relations

Stepping up Production

Industrial Production to-day is at a low ebb ; and with it an ugly mark has been left on industry, on its Labour and Management. On account of increase in prices and lack of sufficient food a demand of a revolutionary type from labour is taking place in the industrial organization of the country. Demand for higher wages and less number of working hours is the cry to-day. The management who have tried to meet their demands to a great extent have to view their new problems with grave concern. The future *labour-management* relations must be conceived from the background of world movements. The A.-I.M.O. has advised the manufacturers time and again to

adopt a more liberalised programme and constructive action in the general interests of the country, while balancing legitimate interests of the labour and management. In doing this we should also consider the legitimate rights and privileges of the technologist and the scientist and not ignore them.

It is high time that Government concentrate on an all-out effort to step up industrial and agricultural production. The Commodity Prices Board recently set up by the Government of India to advise them regarding fixation and control of prices, in its report to the Government, present a grim picture for the next few years. They see little prospect of increase of the agricultural output per acre for the next three years, India's dependence on foreign foodstuffs for some more years resulting in the diversion of purchases of capital equipment. This would result in hindering industrial production. It is desirable, therefore, that the Government maintain the price at a level, and there should be no further increases except in special cases where they find it absolutely justifiable.

Village Industrialization

The A.-I.M.O. has put forth a well-conceived and scientifically planned village industrialization scheme, so that India can have units of groups of villages with a prosperous economy. If the scheme is taken on hand and put into operation immediately by the Government or the people of the rural areas or by public organizations, the villages will become self-sufficient in course of time with regard to food-stuffs and other commodities.

Heavy Industries

Before concluding my remarks I may once again appeal to all progressive people of this country to co-operate in the programme of the A.-I.M.O. for the early establishment of at least a few Heavy industries in the country. The A.-I.M.O. has published a scheme for an all-round development of Heavy Industries in the country. The Government should assist in the establishment of heavy and key industries and provide facilities for the *entrepreneurs* to go ahead with their plans. With the growth of large-scale and basic industries innumerable secondary or medium and small-scale industries would automatically grow.

Let me also take this opportunity to urge upon both the Government and the people to strive for a common basic educational system at the primary and secondary school-leaving stages, with a view to creating a spirit of nationalism and nationhood from the early days of training so that the future citizens would think and act as one nation.

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BRITISH FISHERY RESEARCH IN ARCTIC OCEAN

THE British Ministry of Agriculture and Fisheries have decided to resume intensive research in fisheries in the vast waters of the North Sea and the Arctic Ocean.

The Fisheries Laboratory at Lowestoft, a port on the East Coast, will soon be given to operate with three research ships under the direction of Michael Graham, one of the greatest authorities in deep-sea fish research.

Two of the ships are used for exploring home waters, tracing the drift of plaice eggs from the spawning grounds to the areas where the eggs develop into young fish. In addition, the trawler undertakes the preparation of charts on which is marked the concentration of both zoo- and phyto-plankton, important with regard to herring fishing.

The collection of samples of fauna on the sea bed helps to discover what it is that fish live on and, for this purpose, the *Sir Lancelot* makes use of a "grab". Study of the fauna supplies valuable knowledge as to the way in which fish feed.

The second research ship will be shortly put to sea in connection with the pelagic fishery, i.e., surface fishery for herrings, sprats and pilchards.

Entirely new ground will be broken when the research ship *Ernest Holt*, to be completed beforelong, starts off for the Arctic waters. Her fittings include a large laboratory, a testing fish room with a capacity of 40 tons, a submersible electric plankton pump, sounding apparatus, as well as many scientific instruments, together with a new refrigerating plant. The ship's hull will be made specially resistant to pack ice.

The waters in which the *Ernest Holt* will operate lie between Spitsbergen, the Boar Islands and the Barents Sea. The ship will be used to explore among other things, the mixing areas of cold and warm ocean currents, and also to discover how they affect the movements of fish.

Scientists expect from these studies to discover why certain fish are met with in certain waters and not in others. The research work of the fishery naturalist ultimately aims at balancing the fishable stock. A check has to be put on the rate of fishing, and the research aims at fixing the maximum rate. Recommendations from the Lowestoft Fisheries Laboratory are reported to have already served as a basis for international negotiations which, it is hoped, will lead to a more rational exploitation of the sea as a rich source of food.

THE VANASPATI PROBLEM

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DURING recent months, a great deal has been said and written on the subject of Vanaspati. Very little of fresh scientific evidence has been adduced, but the public mind is greatly agitated following the publication of varied statements and reports regarding the nutritive value of the product and its possible effects following continued usage as an article of food. The publications come in three categories :—(*i*) expressions of opinion by different consumers which, though not strictly scientific, are still entitled to respect because they are based on actual experience ; (*ii*) general statements reported to have been made by scientific workers and which have been cited for or against the industry ; (*iii*) letters and summaries bearing on previous work on the subject and which are now appearing in scientific journals. None of these has proved conclusive. The opinions of consumers are divided, the general trend being in favour of a cautious approach, pending definite and conclusive scientific evidence. The statements by scientific workers and important Government members are often misquoted with the result that in some cases the persons concerned have themselves been obliged to issue subsequent corrections and contradictions. On the whole, the general trend of opinion is in favour of reserving judgment pending the collection of more evidence in regard to the various aspects of the subject.

The Vanaspati industry in India is of comparatively recent origin, having started from small beginnings in the early thirties. The product soon gained in popularity as there was a demand for a cheap preparation with a similar appearance, taste and flavour which could wholly or partly replace ghee as a cooking medium. The turn-over increased from year to year and the manufacture now ranks as one of the major food industries in the country. The capital and the equipment already engaged may be valued at twenty crores of rupees and the annual production at about thirty crores. The industry employs a few thousands of hands and has also stimulated a few subsidiary industries[1]. Apart from vanaspati for food, the industry has also produced hardened oil for the soap industry, vegetable tallow and a variety of other products which are finding extensive application. Side by side with these, the industry also produced and is presumably, still producing, a specially hardened product which is in demand for adulterating ghee. Every vanaspati manufacturer may not produce such a product, but there is no doubt that many still continue to do so. It is this last product which led to the earlier prosperity of the industry and subsequently led to a good deal of trouble, disappointment and even diffidence in the future of the industry.

The industry is now awakening to the importance of producing a clean, wholesome product which can stand on its own merits. The Government is also insistent on the marketing of a product which will conform to certain specifications. These will, to a large extent, exercise a check on the use of hardened oil for adulteration. In its own ultimate interests, the industry will also have to exercise strict discipline and discourage the use of vanaspati in any form of adulteration.

State Decision to Expand the Industry

Acting on the recommendation of a special Committee and also of the legislature, the Government decided in 1945 to encourage the expansion of the industry to roughly three times its present capacity. A target of 450,000 tons per annum was set up, and it was reckoned that the full expanded capacity will be reached by 1950. The primary reason which led to this decision was the increasing shortage of ghee and its non-availability to the poorer sections of the people. Vanaspati was becoming popular as the poor man's ghee, but there was not enough of that product, though the raw material (crude vegetable oil) was plentifully available. The expansion of the industry was accordingly planned, and the different provinces were allotted their quota of factories. About forty new companies have been floated, and in view of the impending prospects many of them were heavily oversubscribed. Reckoning at an average of about ten lakhs of rupees for each new concern, the capital involved in the new flotations may be estimated at about four crores of rupees. Substantial orders for equipment and accessories have been placed in Europe and elsewhere, and it is expected that some of the new factories will be created and begin production in 1948, if not earlier.

It is not unreasonable to expect that the tripling of the production in such a short period as three years (from 1947) will lead to some temporary glut on the market. Even if the production and distribution are regionalised, there is a fair prospect of the public demanding certain brands of products which have already established their name in preference to others. The preparation of a fully acceptable product is not altogether simple, and some, at any rate, of the new companies will have a certain amount of difficulty in standardising and successfully marketing their products. Although monopoly in industry is unhealthy, the experience gained by the already established firms would have proved very valuable in expanding the industry at a rate in keeping with the actual rise in demand.

The Recent Change in Outlook

About the time that the Interim Government came into office in 1946, apprehension was expressed in several quarters about the possible consequences of the fairly large expansion of the industry. There was also a good deal of objection to the use of vanaspati, in any form, as an article of food. The ghee manufacturers also protested against the proposed increase in the production of vanaspati as that would militate against the interests of their industry. Butter and ghee represent two of the most

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important products of the dairy industry in India, and it was naturally argued that large supplies of vanaspati would reduce the demand for ghee or otherwise lower the market value of the latter. Added to this, the more recent observations reported by Ray and Pal[2] regarding the prolonged effect of feeding vanaspati as the main source of fat to successive generations of experimental animals led to further misgivings about the use of vanaspati as an article of human food. Other laboratories in India did not report similar effects; but their conditions of experimenting were not quite the same: nor were the observations made over such long periods as that reported from Izatnagar. The Izatnagar observations were also apparently at variance with those reported by scientific workers in other parts of the world[3–5]; but they had nevertheless been made by experienced workers of standing whose opinion is entitled to respect. It is possible that there may have been some peculiar features about their experimental conditions or about the products they had compared; but their work revealed the need for a careful examination of the position with special reference to the conditions prevalent in India. This naturally led to a good deal of uneasiness in the minds of the consuming public. The Government was also greatly perplexed. While on one side, they stood committed to expanding the industry, they were led to doubt whether even the existing industry was justified. They were nevertheless very cautious and in his address to the Food Technical Panel on 26th November 1946 Dr. Rajendra Prasad, the Member for Food and Agriculture, stated that though he felt very uneasy about the position, he was nevertheless prepared to await the conclusive and concerted opinion of scientists in regard to the subject. Acting on his advice, a Committee composed of representatives of the different laboratories interested in food and nutrition problems was appointed to go fully into the question and to conduct such fresh research as may be needed prior to making its final report to the Government.

The Present State of Our Knowledge Regarding the Nutritive Value of Margarine and Vanaspati

There is extensive literature regarding the relative nutritive values of margarine and butter. It is now generally accepted that high-melting fats (m.p. 45° C. or more) are rather difficult to digest, though, even recently evidence has been obtained to show that fats with melting points up to 50° C. are digested to nearly the same extent as those with lower melting points.[6–9] Even starting with fats of the same melting point, butter-fat would appear to be superior to the vegetable product[10–12] though in actual practice, the difference is not much seen when the diet is otherwise quite adequate. Theoretically, a similar observation should apply to vanaspati of melting point which is of the same order as that of ghee. Quantitative data with vanaspati of m.p. 37° C. are not yet available, but the earlier products on the Indian market which were of higher m.p. have not produced the same response as ghee even when moderate supplements of vitamins are provided. These observations require to be confirmed.

Ghee prepared out of good dairy butter may be regarded as an ideal form of fat. While that may be maintained as the standard, comparison of vanaspati should also be made with vegetable oils to determine whether the process of hydrogenation and the materials employed therein have produced any marked difference in regard to the food value of the oil and the utilisation of the other food constituents. In this direction also, some literature is available.[13] When the diet is adequate, there does not seem to be much difference between oil and vanaspati.[14] A good brand of vanaspati contains less than 0·5 p.p.m. of nickel* which is non-injurious. The iso-oleic acids formed during hydrogenation do not appear to have any pronounced effect,[15] though, here again, more scientific evidence is needed. The nature and proportion of iso-oleic acids can vary, depending on the procedure followed.

Most of the earlier studies have been with experimental animals receiving adequate diets. Such diets are not normally consumed even in the most prosperous countries which are also comparatively free from religious and sentimental restrictions in regard to the choice of diet. In India where the great majority of people consume a predominantly cereal diet which is also deficient in regard to various food accessories the position in regard to fats would require careful investigation. This would be particularly true of the poor rice diet of South India which is highly lacking in proteins, minerals and vitamins. The evidence already obtained would suggest that with such a diet, there would be poor response even to butter-fat.[16]

Programme of Vanaspati Research

The above facts were fully appreciated by the Special Research Committee appointed by the Technical Panel to go into the question. The Committee which met on 28th January 1947 decided that, before pronouncing any opinion about the nutritive value of vanaspati, there should be an extensive series of comparative studies both with experimental animals and with human subjects. The animal experiments, as now planned, are probably the most elaborate ones yet carried out on the subject. The following five products, fed at 5 per cent. level, will be compared:—(*i*) ghee as prepared out of dairy butter; (*ii*) crude groundnut oil; (*iii*) refined groundnut oil as prepared out of (*ii*); (*iv*) vanaspati of m.p. 37° C. as prepared out of (*iii*): (*v*) vanaspati of m.p. 41° C. as prepared out of (*iii*). The basal diets would be the following:—(*i*) synthetic diet adequate in regard to protein, minerals and vitamins; (*ii*) poor rice diet as used in South India and adopted in a number of earlier researches;[17] (*iii*) poor rice diet plus extra vitamins; (*iv*) poor rice diet plus extra protein

* In some of the preparations on the market nickel upto 10 p.p.m. or more is encountered. This is due to faulty neutralization. As nickel in more than minimum quantities imparts a bad taste and hastens rancidity, there should be rigorous control over the permissible quantity. The permissible limit should be fixed by the Government.

as casein; and (*v*) poor rice diet plus calcium. Apart from growth measurements there will also be metabolism studies following the extent of utilisation of fat, protein and minerals in the different cases. The reserve of vitamin A in livers will also be followed on completion of each series. Representative animals of each group would be bred and the offsprings, after weaning, placed on similar diets for a further series. In this manner, the experiments would be continued for three generations. As now programmed, the animal experiments following the same details will be carried out in four laboratories— the University College of Science, Calcutta, the Indian Dairy Research Institute, Bangalore, the Indian Veterinary Research Institute, Izatnagar and the Indian Institute of Science, Bangalore. The results obtained by all the laboratories will be pooled together before drawing any final conclusion.

The Committee was conscious of the difficulties in maintaining experimental animals on a poor rice diet. The difficulties in breeding animals reared on such a diet was also realised. Albino rats do even more poorly than human subjects on the South Indian rice diet. This is an aspect which requires careful investigation. There are of course some features which differentiate the experimental diet from the diet as actually consumed in South Indian homes. They may be more important as factors in nutrition than has hitherto been realised.

The human metabolism experiments which would be detailed studies bearing not only on the utilisation of the different preparations, but also the attendant protein and mineral metabolism would also be followed. As in the case of the animal experiments, the poor South Indian rice diet would form the basal diet for these studies. The experiments, as now planned, are being carried out at Coonoor, Bangalore and Calcutta. The third series of studies would consist of institution feeding experiments at Bombay, Delhi and Mysore. For these studies, children under fifteen from institutions receiving a predominantly poor cereal diet have been selected.

In this case the comparison will be only between the crude oil and vanaspati of m.p. 37°C. and the object primarily to determine whether any characteristic effect which is not observed in the case of oil is noticeable in the case of vanaspati. Here again, the oil or vanaspati will form five per cent. of the total solid matter in the diet. The children, who will number a few hundreds at each centre will be under experiment and systematic health observation for at least six months. Where facilities exist, metabolism studies will also be carried out.

It is difficult to forecast whether even an elaborate study such as represented by the above programme will give a conclusive answer in a short time. The animal experiments will cover the best part of two years. The human feeding trials may have to be prolonged, and some may even require repetition at other levels. There will, nevertheless, be a useful amount of evidence which would be a pointer for such further work as may be needed.

The programme of research, as now planned, will, among other things, help to throw some fresh light on the fat metabolism of people who are on a predominantly vegetarian diet composed mostly of cereals or millets. The fat requirement of people on such a diet seems to be considerably less than has hitherto been assumed. The work will also throw further light on the nature of factors assisting in the utilisation of fat in the human body.

The Outlook for the Future

One might well ask as to what should be the State policy in regard to the vanaspati industry till some conclusive evidence is obtained. In addition to the older factories, the new ones will also be soon coming into production. What should be done with all the output? This will be a very difficult question to answer. The industry should not be paralysed and, at the same time, the interests of the public should be safeguarded. Acting on proper technical advice, the Government has already legislated that the melting point of vanaspati should be less than 37° C. This would be lower than that of buffalo ghee obtained in some parts of the country, particularly during certain seasons. It has also been legislated that all brands of vanaspati should contain 5 per cent. sesamum oil so as to permit of easy detection when used for adulteration of ghee; that the product should not be labelled or advertised as vegetable ghee and that ghee vendors should not sell it. These are desirable controls, and the industry has also accepted them. *Any further reform or control could be introduced only on the basis of fresh scientific evidence.*

The State and the industry will have to face the problem of an immediate glut on the market when the new factories come into production. Even at the present level of production, there seems to be no shortage of vanaspati. A consumer can purchase any desired quantity without much hardship though here and there, temporary shortage may be noticed. The present position would suggest that vanaspati is chiefly consumed by a section of the community whose number is not large and which is not increasing at a fast rate. It would be very useful if, side by side with the scientific study, some statistics could also be collected regarding the class of users of vanaspati and their approximate consumption *per capita*. Such information will not be difficult to obtain, and, when obtained, it would be very helpful both to the Government and the industry.

In the event of there being a marketable surplus from the expanded industry, there should be plans for the best utilisation of the product. Solid fats have a variety of applications, and it should be the joint effort of both science and industry to find the best possible uses for the products. From this point of view, the decision of the industry to institute Research Fellowships and to establish a Faculty for oil-seeds, oils and fats should be welcomed. It would be useful to consider the hydrogenation of not only edible oils, but also non-edible ones. The latter do not seem to have been well exploited.

The scientific evidence now collected by the different laboratories would only help to show whether refining and hydrogenation carried to a certain point have any pronounced effect on the nutritive value of the vegetable oil. Even

if no serious difference is observed, the product would still not be equivalent to pure ghee. As in the case of margarine, vanaspati should be fortified with vitamin (or provitamin) A and also with vitamin D if it is to become a 'poor man's ghee'. It may also require supplementing with additional glycerides of special value in nutrition.[18-20] The desirability of using mixtures of different vegetable oils instead of a single cheap oil, as is now generally the case, may also require consideration. Improvements should be steadily made both on the initiative of the industry, and, where necessary, also by State legislation. Scientific research along these lines should be continued.

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ABNORMALLY HEAVY RAINFALL IN INDIA — TEMPERATURE INVERSIONS IN TROPICAL AIR MASSES

S. L. MALURKAR

(*Poona* 5)

THE frequency of heavy rain in 24 hours, in the course of nearly 30 years have been published.[1] Occasions when more than 10" of rain fell in 24 hours have also been recorded.[2,3] The data are based on observations taken at nearly 3,000 provincial rain-gauge stations distributed over India. It is of interest even to attempt a tentative explanation of such rainfalls and their distribution. An analysis of 10" or more in 24 hours, recorded over such a long period is hardly likely to lead to an easy solution, and becomes theoretically unwieldy. It is possible, however, to raise the limit of rain above which one has to consider. The places recording 15" or more in 24 hours were noted on a large map of India (scale 1" = 32 miles). The distribution of places where these abnormal amounts fell has a definite scatter leaving out of account some individual stations. The scatter could be broadly grouped under (*a*) East Gujarat near about the Gulf of Cambay, (*b*) South Assam near the Cachar Valley, to a lesser extent, (*c*) near the Circars and Coromandel Coasts, and finally, (*d*) the individual stations. It looked obvious that data in regions (*a*) and (*b*) would help, by analogy, to explain the instances under (*c*) and (*d*).

As the data refer to an extended series of years over fairly well-distributed rain gauge stations, the conclusions drawn from them *would be generally valid.*

East Gujarat is well north of the Western Ghats. The places that have had a record of heavy rain near the Ghats are Igatpuri (about 80 miles E.N.E. of Bombay) and Malcolmpeth (Satara District.). Some of the rainiest places in Mysore hardly touch 10" in 24 hours. The average height of the Western Ghats decreases northwards. The rain, therefore, cannot be explained merely by Orography. Similarly, in N.E. India and Burma, one would have expected that the higher level stations along the Arakan Yomas, which are in the path of the monsoon winds, would show instances of very heavy rain as in South Assam. Kanpetlet (Lat. 21° 10' N., Long. 93° 59' E.; ht. 6,322 ft.) though considerably higher than Cherapunji (4,309 ft.) has not recorded even as heavy a rainfall.

The heavy rains at Cherapunji mostly occur when the monsoon over North India, i.e., west of Cherapunji, is relatively weak.

Abnormally heavy rain occurs in and near East Gujarat associated with a depression to the east of the place. It is commonly observed that abnormally heavy rain occurs when a depression is almost filling up. When abnormally heavy rain fell in East Gujarat and S.E. Rajputana, the monsoon depression which had caused the abnormal rain did not travel much further west,[4] i.e., the monsoon to the west of Gujarat and S.E. Rajputana would be weak. This shows the analogy in the case of South Assam.

For the formation of a tropical depression in the monsoon and non-monsoon months it is necessary to have three air masses:[5] (*a*) Em—Equatorial Maritime air which come from the other side of the equator—it can be made easily unstable and gives rise to thunderstorms; (*b*) Tr—a mixed Transitional air whose ultimate origins are the high pressure areas of the North Pacific and the North Asiatic continents. It flows along the displaced "N.E. Trades". Though this air is hot and moist and becomes more so in its travel in the S.W. monsoon due to its equator-ward motion, it gains in stability along its path (except perhaps when very near the equator and when about to cross to the other side); and (*c*) Tc—Tropical Continental air, a dry hot air.

A tropical depression fills up or recurves to a northeasterly direction when the supply of Em is cut off[6] and behaves like an extra-tropical depression with only two sectors. The extra-tropical disturbances are more or less active as the "N.E. Trades" feed into it or move away from it. The recurved tropical depression is an extreme case of the "N.E. Trades" feeding into an extra-tropical depression.[7]

As the supply of Em is cut off, when a depression is filling up, the abnormally heavy rain can only be assigned to Tr. Before the recurvature of the tropical depression, Tr has a slightly equator-ward motion and is gaining in stability at lower levels. Its moisture content and temperature are also increasing in the lower levels. As a result of this, a temperature inversion is set up in it which magnifies the stable nature of the air (*infra*). When the depression recurves, Tr becomes the moist and warm sector, and has a pole-ward movement. The hot moist stream which was gaining in stability (as shown by isothermal layers and temperature inversions) now develops latitudinal convergence and gets to be less stable in its N. or N.E. motion, the isothermal layers and temperature inversions get destroyed. The previous temperature inversion has helped in storing large energy. The effect of convergence or divergence with change in latitude is more marked nearer the equator than elsewhere. At the stage of recurvature of a tropical depression, a sort of front, extending from S.W. to N.E. with heavy rain along it develops in the depression.[8] The degree of abruptness with which Tr which till then had an equator-ward motion is *bent back* to a pole-ward direction determines the heaviness of the rain or to put it in other words, the change from stabilising to unstable conditions in the Tr is responsible for the heavy rain. The season and locality are necessary as the properties of Tr depend on them, *i.e.*, the amount of moisture and temperature the air has acquired before getting a pole-ward motion.[9]

The recurvature occurs due to a western disturbance moving in a more northerly latitude, and the rear of the latter provides the fresh Tc to the recurved depression and gives more contrast with Tr than before recurvature. The partition between Tc and Tr gets to be more marked.

During the S.W. monsoon months, the depressions form at the head of the Bay of Bengal and near Kathiawar.[10] The approximate positions of Tr should be to the N.E. of the places.[11] The Tc for depressions about Kathiawar would be from West Asia and adjoining regions of India. Tc for the depressions that form near the Gulf of Siam and Upper Burma would be from Upper India. The heavy rain in South Assam should, therefore, be due to the depressions that recurved over Siam and Upper Burma, and the mechanism should be similar to that which occurs in East Gujarat, *i.e.*, the bending back of Tr with the recurvature of a monsoon depression to the east of the place.

The above explains why a monsoon depression which remains stationary in the west United Provinces gives rise to heavy rain.[12] Under the influence of a western disturbance travelling far north and cutting off of fresh supply of Em, the Tr of the depression is given a northerly bend giving rise to heavy rain.

The heavy rain that falls along the Circars coast is due to the depressions from the Bay of Bengal. The depressions may themselves recurve and produce very heavy rain as in the first few days of June 1941. Due to distribution of land and sea, the other alternative would be the refraction of the trajectories of Tr to the north which would again be conducive to the production of heavy rain. It is well known that heavy rain falls very near the coast just about the time a depression moving in some westerly direction crosses the coast. After crossing the coast, if the depression tends to fill up, there is again a downpour of rain.

The question of *bending back of Tr towards the north coupled with a fresh supply of Tc giving rise to heavy rain* has been verified in a number of particular instances, and is being followed up. The abnormal amounts of rain that were recorded at Bombay on 10th September 1930 (22″) and on 9th September 1946 (9″) seem to have the same cause. In both cases a depression which was to the east of the place filled up about the same epoch.

The bending back of Tr shows as the wedges in the case of the western disturbances in winter and have been stressed elsewhere.[13] The weather only occurs, apart from orography, only where the air is ascending up the latitude.

The problem of heavy rain and its location is reduced to the following of the recurvature or filling up of a depression or the tracing of Tr carefully.

Temperature Inversions in Tropical Air Masses.—As rainfall is intimately connected with convection, a digression on this subject is called for. When an air stream is moving towards the north or south pole, there is latitudinal convergence or there is a tendency for upward convection in the air mass which is calculable. The upward convection would be indicated by a high lapse rate and an absence of a temperature inversion. When, however, the air has an equator-ward motion there is latitudinal divergence and the tendency is for the air to descend. The air stream is gaining in stability and is having slow subsidence (rapid subsidence cannot extend over a long period or area). The lapse rate tends to be below the adiabatic one. The stability of an air mass is, in fact, determined by its capacity to stop convection. This stability increases as the lapse rate decreases from the usual dry or wet adiabatic values. The lapse rate can become zero, *i.e.*, lead to isothermal layers or even become negative leading to temperature inversions. It follows that an equator-bound air stream would exhibit isothermal layers and even temperature inversions.

If the equator-ward moving air stream is passing over a large stretch of water or swampy land, due to its increasing temperature along its path, it would absorb moisture. As the amount of convection is small due to the small lapse rate, the moisture would be confined to lower levels of the stream: below the isothermal or inversion layer. Due to differential effect of radiation, the moisture in the lower levels would give rise to an inversion or sharpen it if one already existed.[14] The picking up of more moisture and temperature in the lower levels and the sharpening of the inversion level due to radiation and due to descent in the latitudes would be the character of an equator-ward moving stream near sea or swampy land. This may be expected to hold good unless the stream is very near the equator and about to cross it to the other side.

Among the equator-ward moving tropical streams Tr is an important one. In the Pacific Ocean and in S.E. Asia it is moving over water or swampy land. Deppermann[15] has given the inversion in the "N.E. Trades" at 1·5 to 2·0 kms. The inversion that occurs over Bengal in the premonsoon months when the "N.E. Trades" have been displaced northwards to that latitude is given a simple explanation. Due to the frequency of monsoon depressions, the thermal structure over Bengal is disturbed, and the inversion is practically wiped out except during long 'breaks' in the monsoon. It is to be made clear that the wiping out is not solely due to the pole-ward moving Em or fresh monsoon air. The only thing this fresh air would do is to allow a parcel of it to pass through the inversion layer. But due to the cyclonic circulation, Tr, which is from the east and had an inversion, gets a slight northerly bend with a tendency to converge, and hence with a tendency for the wiping out of inversion. It is not possible to dynamically figure out the formation of inversions and their wiping out by advection of one or more air masses.[16,17] in the tropics without bringing in the latitudinal changes and radiation.

The inversions at Karachi are due to Tc flowing slightly equator-ward over the Persian Gulf and the North Arabian Sea during the monsoon months. Over lower Sind, the paucity of depressions and less chance of latitudinal convergence make the inversions more persistent about the height of 1·0 km. The deepening of the inversion layer as one moves from Mekran to Kutch also becomes understandable.

A reference to the radio-sonde observations of Addu-Attol, in the old Indian Daily Weather Reports, often shows isothermal layers, and, occasionally, temperature inversions during the northern summer. When the air is about to cross the equator, there is hardly any inversion.

The formation of a temperature inversion is very important as it allows sufficient moisture to accumulate without its being dissipated by convection or immediate thunderstorms. It conserves the moisture and the energy for later release if needed.[18] The inversion in Tr south of the equator, explains the shallow depth of the S.W. monsoon in the neighbourhood of the equator. The diurnal variation of temperature at Nuwara Eliya is nearly 12° F. even on a good monsoon day, showing that the hill station is not well within the monsoon stream. At Mahabaleswar the diurnal variation of temperature is sometimes as low as 2° F. The Mannar and Trichinopoly upper winds also show such variations. The depth of the S.W. monsoon increases with gain in latitude, partly due to sea travel and partly due to latitudinal convergence. Similarly the shallow layer of moisture of the N.E. monsoon in northern winter is explained by the Tr north of the equator having an inversion at about 1·5 kms. This air crosses to the southern hemisphere at intervals to feed the monsoon there. The radio-sonde and aeroplane ascents and the extreme dryness at the high hill stations in South India all show the existence of temperature inversions in the "N.E. Trades" in northern winter.

The data are being further studied.

1. *Memo. India Met. Dept.*, **23**, 413–520. 2. *Ibid.*, **21**, 1–110. 3. *Ibid.*, **25**, 109–43. 4. Malurkar, *Forecasting Weather In and Near India*: Printed in Bangalore, limited number, May 1945 (released Nov. 1945). 5. *Ibid.*, p. 34, and p. 87. 6. Malurkar, *Curr. Sci.*, 1947, **16**, 14. 7. —, reference **4**, p. 139. 8. Normand, *Gerl. Beitr. z. Geophys.* 1931, **34**, 233. 9. Malurkar, reference **4**, p. 91. 10. *Ibid.*, p. 39. 11. Malurkar, *Curr. Sci.*, 1947, **16**, 148. 12. —, reference **4**, p. 48. 13. *Ibid.*, p. 110. 14. —, *Gerl. Beitr. z. Geophys.*, 1932, **37**, 415. 15. Deppermann, "Outlines of Philippine Frontology," Manila, 1936. 16. *Winter Rain in the United Provinces and North-westers in Bengal* (in press), and Chatterjee and Sur, *Memo. Ind. Met. Dept.*, **26**, 171. 17. References to Field in Chatterjee and Sur's paper in the above, and Hariharan, *Sc. Notes, Ind. Met. Dept.*, **5**, 41. 18. Malurkar, *Proc. Indian Ac. Sci.*, Sec. A, 1943, **18**, 26.

THE CENTENARY CELEBRATION OF THE CHEMICAL SOCIETY, LONDON, AND THE ELEVENTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY*

THE Centenary of the Chemical Society, London, at which nearly 1,500 chemists were present, was celebrated in the Central Hall, Westminster, on Tuesday, July 15th; Prof. C. N. Hinshelwood, President of the Chemical Society, presided. Eminent chemists representing the Science Institutions of twenty-eight countries, including France, U.S.S.R., America, Switzerland, Sweden and India, participated in the celebrations. Dr. S. Krishna of Dehra Dun represented India on the occasion. The opening was preceded by a reception at which the distinguished visitors and delegates were received by the President and the Council. Prof. Raymond Delaby, President of the Chemical Society of France, read on behalf of all the delegates from overseas, a message of congratulations to the Society on the achievement of its Hundredth Anniversary. Representatives of Societies from overseas then presented their written addresses of congratulations. This was followed by greetings by Sir Robert Robinson, President of the Royal Society, London, on behalf of the sister Societies in the United Kingdom.

To mark the event, an Exhibition was opened on July 14th at the Science Museum by Prof. Hinshelwood; Mr. George Tomlinson, Minister of Education, presided. Mr. Tomlinson described the gathering as an expression of international friendship and co-operation at its best. The Exhibition is in three sections—Historical—a display illustrating Chemistry in every-day life, and a section of Books on Chemistry. The Historical Section, arranged by the Chemical Society, is concerned with the achievements of British Chemistry during

* A summary report by Dr. S. Krishna who represented India on the two occasions.

the past century, and includes among its exhibits many historic pieces of apparatus. The range is from Faraday's experiments on liquefaction of gases to Sir Alexander Fleming's discovery of Penicillin. Between these extremes lie such things as Perkin's discovery in 1856 of the dye 'Mauve', and Bragg's work on crystal analysis. In the section on Chemistry in every-day life, which has been organized by the Department of Scientific and Industrial Research, an interesting sequence of exhibits shows how chemistry is to-day affecting all aspects of domestic life. It includes sections dealing with such themes as textiles, buildings, roads and transport, fuel, power, health, and food. The exhibition constitutes one of the most comprehensive displays in the history of science yet seen in the United Kingdom.

Before an audience described as the "most representative and distinguished gathering of chemists ever seen in London", Sir Robert Robinson delivered the Faraday Lecture on "the Development of Electro-Chemical Theories of the Course of Reactions of Carbon Compounds", and received the Faraday Medal—the highest honour that can be bestowed by the Chemical Society. The lecture was preceded by a dignified ceremony at which Prof. N. J. Bjerrum (Denmark), Prof. J. N. Bronsted (Copenhagen), Sir Henry Dale (Britain), Prof. George C. Hevesy (Stockholm), Prof. P. Karrer (Zurich), Prof. L. C. Pauling (U.S.A.) and Prof. Ruzika (Zurich) were formally admitted to the Society as Honorary Fellows. The most impressive of all the ceremonies was the Graduation ceremony at which the London University conferred Honorary degrees of Doctor of Science (*honoris causa*) on Professors Bronsted, Hinshelwood, Karrer and Pauling. This was followed by a dinner by the Duke of Athlone, the Chancellor of the University.

The Prime Minister attended the Centenary Dinner of the Chemical Society, at the Dorchester Hotel on 15th July. He said that "the party to which he belonged had for many years been anxious to make changes in the organization of the Society, but the changes it was carrying out were insignificant compared with those brought about by the Chemist". As a politician, the moral he drew was that the Government must keep close touch with the Chemist. Mr. Attlee concluded his speech by saying that "Science, like music and art, was international. It should be one of the things which bound the peoples of the world together, not something which separated them". Responding to the toast, Prof. Hinshelwood said that "Chemistry, like all sciences, was a tree of good and evil. The powers that it conferred were mighty, and they could be terrible. The control of them was a matter for the general conscience of mankind". Further on he described "as a welcome sign in the past few years the increasing number of scientific papers published from the chemical industry: clear evidence that leaders of that industry were showing understanding of the intellectual needs of the men who served it". "One can only hope, he added, "that the whips of commercial secrecy will not be succeeded by the scorpions of military security." At a luncheon given by His Majesty's Government, Mr. Herbert Morrison, Lord President of the Council, said that "Young chemists should pursue fundamental research, but the modern world required that the time-lag between scientific discovery and application must be short."

During the celebrations which lasted three days (15th to 17th July) visits were arranged to the British Drug Houses; the Distillers Company Ltd., Epsom; Kodak Ltd., Harrow; the Research Institute, Beckenham; Chemical Research Laboratory, Teddington; and the Fuel Research Station, East Greenwich.

Receptions were held by the Imperial Chemical Industries, the Royal Society, and the Royal Institution.

The Centenary Celebrations were followed by the Eleventh International Congress of Pure and Applied Chemistry which opened at the Central Hall, Westminster, on 17th July. Lord Leverhulme, addressing 2,000 delegates from all over the world, said that the Congress was a "significant act of international co-operation. A better understanding of the world might well be promoted by a gathering like that which had brought together men and women from nearly thirty countries, all united in one common purpose—the progress of the science of Chemistry". Nearly 400 papers were presented, but a significant omission was that of any direct reference to nuclear energy. This was explained by Sir Wallace Akers, who was Director of Research in Atomic Energy during the war, to the press, saying that "the Government that had knowledge of these particular developments had decided to impose an embargo on that Knowledge until some other arrangement was made. It is well known to chemists engaged in atomic energy research that their information was only a fraction of what was known, and it was impossible for an honest person to present to the Conference anything that purported to make a serious contribution to the chemical aspect of the development."

Conferences of fourteen sections of the Congress were held simultaneously in separate rooms at the Imperial College of Science and Technology, South Kensington. The sections were the following with the names of their Presidents in brackets:—(1) Inorganic and Geo-Chemistry (Prof. H. V. A. Briscoe), (2) Physical Chemistry (Prof. S. Sugden), (3) Organic Chemistry (Prof. A. R. Todd), (4) Bio-chemistry (Prof. A. C. Chibnal), (5) Chemistry in relation to Agriculture and Applied Botany (Prof. T. Wallace), (6) Chemistry in relation to Applied Zoology and Veterinary Sciences (Dr. W. R. Wooldridge), (7) Chemistry in relation to Food and Nutrition (Sir Jack Drummond), (8) Chemistry in relation to Medicine and Therapeutics (Dr. C. H. Harington), (9) Chemistry in relation to Fuel, Power and Transport (Sir Alfred Egerton), (10) Chemistry in relation to Natural and Artificial Textiles (Sir Robert Pickard), (11) Chemistry in relation to Elastomers, Plastics, Glass, and Ceramics (Prof. H. Moore), (12) Chemistry in relation to Metals (Mr. S. Robson), (13) Chemical Engineering (Dr. A. J. V. Underwood), (14) Chemistry in relation to Essential Oils, Flavouring Materials and Cosmetics (Mr. R. K. Allen).

The discussion covered a wide field. For example, in the Nutrition Section addresses

were delivered on the experiences of groups of men who were deprived of adequate diets in occupied territories, prisoners-of-war camps and elsewhere during the war. The chemistry of underground gasification of fuel was discussed by Dr. Demart of Belgium. The paper on the control of tsetse fly was of interest from the point of view of development of food production in Africa. The raw materials of rayon manufacture were discussed by Dr. Levenstein, and the production, properties and uses of seaweed rayon by Prof. Speakman.

Apart from the sectional meetings, there were several Congress lectures. These were delivered by: (1) Prof. L. Pauling (U.S.A.), on the nature of bonds in metals and intermetallic compounds; (2) Sir Henry Dale (U.K.), on the part of chemistry in the new therapeutics; (3) Prof. P. Karrer (Switzerland), on some recent advances in organic chemistry; (4) Prof. A. Tisalius (Sweden), on the recent development in electrophoresis; (5) Prof. L. Hackspill (France), on La corbura de calcium et ses propertés reductrices; (6) Sir Howard (U.K.), on some biological properties of chemotherapeutic antibiotics. Sir Robert Robinson delivered the closing address. The next International Congress will be held in 1949 in Holland.

INDIAN STANDARDS INSTITUTION

THE Indian Standards Institution, referred to as ISI (pronounced "Eye-Sigh") for short, which brings India in line with other countries of the world, has been established under the auspices of the Industries Department of the Government of India. The Central Government has undertaken to finance this Institution for the first five years with an annual grant of two lakhs of rupees, which grant is being handsomely supplemented by the various Provincial and State Governments as well as the industry of the country. It is hoped that, in due course, industries will be able to support the Institution without any help from the Government.

There already exist in India certain standardisation organisations such as the Inspection Wing of the Directorate-General of Industries and Supplies, Central Standards Office of the Railway Board, Inspectorate Organisation of the Master-General of Ordnance, Development Organisation (Armaments) of the Defence Department, Bureau of Standards (Medical Institutions), Directorate-General of Indian Medical Service, Indian Drugs Act, Agmark Standards, etc. All these have been initially conceived to meet the requirements of a specific department of the Government who are large-scale purchasers of the industrial output of the country. The functions of the ISI, *vis-a-vis* these organisations will be to co-ordinate the standards of general interest prepared by them and promote them on an all-India basis.

ISI has its headquarters at New Delhi in Jaisalmer House on Mansingh Road. Affairs of the Institution are administered by the General Council, on which are represented departments of the Government of India, Provinces and States, professional societies of engineers and scientists, Chambers of Commerce, industries and other important interests. The Director is responsible for the conduct and activities of the Institution. The technical work for the preparation of standards is to be dealt with through various technical committees appointed by one of the five Divisional Councils, namely, (*a*) Engineering, (*b*) Buildings, (*c*) Textiles, (*d*) Chemicals and (*e*) Agricultural and Food Products Division Councils. Of these, it is proposed to organise only two Councils at present, namely, Engineering and Textile Division Councils.

The membership of the Institution is divided into two categories—the Sustaining Members and Ordinary Members. Sustaining membership is open to companies, firms, educational institutions and other corporate bodies, while the ordinary membership is intended for individuals interested in the work of the Institution.

The producers as well as the large-scale consumers such as the Government Departments are well organised and can readily voice their opinions in the shaping of standards. It may be stated that with the establishment of popular governments at the Centre and elsewhere, the Government representatives on the various bodies of the Institution may be relied upon to keep in mind the interests of the masses. Eventually it may become possible to develop in the country such consumers' organisations as exist in the United States of America, United Kindom and elsewhere.

It is the intention of the ISI to introduce what will be known as Standards Mark or Marks. The privilege for the use of these Standards Marks in conjunction with goods offered for sale will be granted to only such producers who give satisfactory evidence of their ability to exercise strict quality control on production and provide laboratory and inspection facilities necessary for ensuring that the goods they produce conform to the relevant Indian Standards.

It must also be realised that the opinion of both the consumers and producers must be backed by scientific tests and carefully planned investigations, and this is where the newly formed National Laboratories organised by the Council of Scientific and Industrial Research will assist. Besides these Laboratories, all other specialised scientific institutions in the country will be called upon to lend facilities for the development of standards relating to their own field of speciality.

The task of standardisation on an international basis will be dealt with by the recently formed International Organisation for Standardisation, ISO (pronounced "Eye-So") with its headquarters at Geneva, Switzerland. The Indian Standards Institution is a member of the ISO and represents India in all matters of standardisation. It should be a matter of great satisfaction to us all that India has been elected to the Governing Council of the ISO for the next three years. India, through ISI, will also act as the Secretariat for the preparation of international standards for Lac and Mica.

Dr. Lal C. Verman, Assistant Director of the Physical Laboratories of the C.S.I.R., has been appointed Director of the Indian Standards Institution.

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ON SPHERICALLY SYMMETRICAL SOLUTIONS IN RELATIVITY

Narlikar[1] has recently reported as new some results regarding spherically symmetrical fields in Relativity. May I say that several solutions for the line-element representing such fields were found out by me[2] in 1939? All such solutions are implicit in the single differential equation arising out of the physical condition of isotropy,[3] *viz.*,

$$T_1^1 = T_2^2 = T_3^3 = -p \qquad (1)$$

in the usual notation. My solutions are similar to those of Narlikar. I am giving below a correspondence between the results given by Narlikar and those obtained by me in 1939 while discussing a cognate problem. For such problems it is customary to start with the following line-element,

$$ds^2 = e^{\nu}\,dt^2 - e^{\mu}\,(dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2). \qquad (2)$$

where $\mu = \mu\,(r, t)$, $\nu = \nu\,(r, t)$. The physical condition of isotropy then yields the second order non-linear differential equation, *viz.*,

$$(\mu'' + \nu'') + \tfrac{1}{4}(\nu'^2 - \mu'^2) - \frac{1}{r}(\mu' + \nu') - \mu'\nu' = 0, \qquad (3)$$

where a dash denotes a differentiation with regard to r.

Of the three cases discussed by me in the paper cited above, the first two correspond to Narlikar's $\beta(r)$ being equal to zero. They are represented respectively by the differential equations,[2]

$$\left.\begin{aligned} \mu'' - \tfrac{1}{4}\mu'^2 - \frac{1}{r}\mu' = 0, \\ 2\mu_{11} - \mu_1^2 = 0 \end{aligned}\right\} \qquad (4)$$

where in the latter differential equation the suffix "1" means a differentiation with regard to χ, $\chi = t^2 - r^2$. These results were, however, obtained directly from (3) on the assumptions $\nu = 0$, $\mu = \mu\,(r, t)$ for the first case and $\mu = \nu = $ constant for the second. The third case is more general, the main assumption for it being that μ and ν can be expressed as a sum and difference respectively of functions of r only and functions of t only, that is, $\mu + \nu = f\,(r)$ with $\theta\,(r)$ $\phi\,(r) =$ constant. It is not, however, necessary to go into any further details in this connection.

Secondly, although Narlikar has stated that equation (1) of his letter is an integral, it is not known of what differential equation it is an integral. I may, therefore, be allowed to state explicitly that his equation (1) giving $\beta(r)$ is the first integral of the differential equation arising out of the physical condition of isotropy. I give below its necessary derivation. The only surviving components of the energy tender are

$$\left.\begin{aligned} T_1^1 = T_2^2 = T_3^3 = -p,\ T_0^0 = \rho, \\ \text{and} \qquad T_1^0 = -\frac{e^{-\nu}}{8\pi}\,(\dot{\mu}' - \tfrac{1}{2}\dot{\mu}\nu') \end{aligned}\right\} \qquad (5)$$

where a dot denotes a differentiation with respect to t. By virtue of the physical condition of isotropy $T_1^0 = 0$, that is,

$$\dot{\mu}' - \tfrac{1}{2}\dot{\mu}\nu' = 0,$$

which gives on integration

$$\left.\begin{aligned} \dot{\mu}^2 = e^{\nu} f\,(t), \\ \text{or} \qquad \dot{\mu} = e^{\nu/2} f^{\frac{1}{2}} \end{aligned}\right\} \qquad (6)$$

Differentiate (6) with respect to r once or twice as required and substitute for ν in (3). After some reduction we get the differential equation, *viz.*,

$$\frac{\partial}{\partial t}\left[\log\left(\mu'' - \tfrac{1}{4}\mu'^2 - \frac{1}{r}\mu'\right)\right] + \tfrac{1}{2} e^{\nu/2} f^{\frac{1}{2}} = 0,$$

which simplifies to

$$\frac{\partial}{\partial t}\left[e^{\mu/2}\left(\mu'' - \tfrac{1}{4}\mu'^2 - \frac{1}{r}\mu'\right)\right] = 0 \qquad (7)$$

This gives on integration

$$e^{\mu/2}\left(\mu'' - \tfrac{1}{2}\mu'^2 - \frac{1}{\tau}\mu'\right) = \phi(\tau) \qquad (8)$$

while the second equation (6) gives

$$\mu = \int e^{\nu/2} f\, \tfrac{1}{2}\, dt + \psi(\tau) \qquad (9$$

(8) and (9) will together yield a relation of the form,)

$$\log \phi(\tau) = \psi'' - \frac{1}{\tau}\psi'' + \tfrac{1}{2} f\tau d\tau \int \frac{1}{\tau}\left(\psi'' - \frac{1}{\tau}\psi\right) d\tau$$

or, $$\log\{\phi(\tau)\} = \psi'' - \frac{1}{\tau}\psi' + \tfrac{1}{2}\psi \qquad (10)$$

giving $\phi(\tau)$ in terms of $\psi(\tau)$ and its derivatives. It will be seen that

$$\phi(\tau) = 2\beta(\tau).$$

As regards the other points mentioned by Narlikar in his letter I shall not discuss them here as these will be incorporated in a separate paper to be communicated for publication elsewhere.

Poona, D. N. MOGHE.
May 28, 1947.

1. Narlikar, *Curr. Sci.*, 1947, **16**, 113. 2. Moghe, *Proc. Ind. Acad. Sci.*, 1939, **10**, 407. 3. *Ibid.*, 1939. **10**, 275.

ANOTHER METHOD OF CALCULATING SQUARES OF NUMBERS

IN a previous article[1] I have given a new method of obtaining squares of numbers, large or small, by mental calculation only. With a view to reducing this mental work further, especially when a majority of figures in the given number are greater than 5, another method is illustrated here.

(1) A number of two digits—88.

88
12
144
76
7744

Subtract the units digit of the original number from 10, and the remaining ones from 9; thus the new number is 12. Square this number, 12, by the method last suggested.[1] It is 144. Double the original number, and enter the first two digits of this product beginning from below the third digit of the last number, as it is necessary to leave out as many digits as there are in the original number. Thus we get 76. Add the numbers together, as in the example, and we get 7744, the required square.

(2) A number of three digits—649.

649
351
123201
298
421201

Subtract the units digit of the original number from 10, and the remaining ones from 9,—351. Square 351—123201. Double the given number, and enter the first three digits of the product beginning from below the fourth digit of the last number as shown in the example—298. Addition gives 421201, the square of 649.

(3) A number of five digits—75684.

75684
24316
591267856
51368
5728067856

Subtract the units digit of the original number from 10 and all the remaining digits from 9—24316. Square this number—591267856, which is written below the line. Double the original number, and write down the entire product, excepting the last digit, in such a way that the units digit of this comes exactly below the sixth digit of the square as shown above. Add together the two numbers between the lines,—5728067856, the required square.

The former method[1] gives the result quicker when the figures in the number are less than 5; whereas by this method the square is obtained more readily with numbers of more than 5 digits.

Statistical Section,
Indian Agricultural
Research Institute,
New Delhi, AZIZUDDIN AHMAD SIDDIQI.
April 9, 1947.

1. Siddiqi, *Curr. Sci.*, 1947, **16**, 178.

AN ADDITIONAL RAINBOW

AT 6-10 p.m. on Monday, the 14th July 1947, there was a heavy shower of rain with the sun shining very bright in the west. Thinking that these were the most favourable conditions for the formation of an almost complete rainbow, I went out and saw, as expected, the usual beautiful rainbow, very intense in colour, forming nearly a full semicircle without any gap, accompanied by the secondary and the supernumeraries which were all explained by Airy on the basis of the theory of diffraction by rain drops.

But one surprising feature of this occasion was the appearance of an extra rainbow. Fig. 1 indicates the size and the dispospition of the additional rainbow with respect to the usual one. The former is given in the thick line to differentiate it from the latter. Its general features were:

1. It was not concentric with the normal rainbow, there being a definite inclination between the two as indicated in the figure.
2. Its intensity was nearly equal to that of the usual secondary rainbow.
3. Only a small portion of it could be seen covering the arc of another circle included between the normal primary and secondary as given in the figure.
4. The portion thus seen was to the south, but its counterpart at the other end of the corresponding circle was almost merged with the northern bottom of the normal primary.

5. There was a slight but unconfirmed indication of a relative movement between the new rainbow and the normal.

On account of the displacement of the new one both with respect to its centre and its inclination relative to the normal rainbow, it must have its origin in the reflected image of the sun at some surface. Such a surface must be a large sheet of water or the surface of a cloud. But the smallness of the displacement does not warrant the former hypothesis. It appears, therefore, that the source for this extra rainbow must be the reflected image of the sun over a cloud. This surface must be the top one as the new bow forms a larger arc of a circle than the normal as is apparent from the figure. A large sheet of cloud was also present in the west in a suitable position for such a reflection to take place. The smaller intensity of the new bow also confirms this hypothesis as the surface of the cloud can only be a poor reflector.

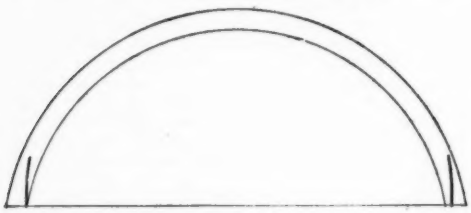

FIG. 1

Further qualitative or quantitative data could not be taken on this phenomena owing to its transient nature.

Technical Research Labs.,
Andhra Scientific Co., Ltd.,
Masulipatam, I. RAMAKRISHNA RAO.
July 16, 1947.

THERMODYNAMIC CHARACTERISTICS OF THE EQUILIBRIUM BUTENE −1 ⇌ BUTADIENE −1, 3 + HYDROGEN

THE above equilibrium was studied experimentally in this laboratory by Ghosh and Roy[1] and accurate values for the equilibrium constant K_p were obtained at five temperatures. From the values of the equilibrium constant an equation was derived[2] for the free energy change ΔF_T of the reaction, assuming the *approximate* specific heat equation.

$$\Delta C_p = 6{\cdot}86 - 0{\cdot}0046\ T + 0{\cdot}000{,}0006\ T^2$$

as the specific heat of butadiene was not then known. When two sets of reliable values for the specific heat of butadiene had become known a re-evaluation was made.[3] After a careful study of existing spectroscopic and calorimetric data, Aston *et al.*[4] have given tables for the specific heats of butene and butadiene, from which it is found that Beck's[5] value for butene assumed in the original paper[2] and in the subsequent note[3] is much too low. The specific heat equation for the above equilibrium on the basis of Aston's results is

$$\Delta C_p = 6{\cdot}256 - 0{\cdot}002734\ T - 0{\cdot}00{,}00{,}0246\ T^2$$

and this in conjunction with equilibrium data[1] gives as the standard free energy equation.

$$\Delta F_T = 25{,}612 - 6{\cdot}256\ T\ 1n\ T + 0{\cdot}001367\ T^2 + 0{\cdot}00{,}00{,}00{,}41\ T^3 + 16{\cdot}05\ T$$

and the thermodynamic characteristics at standard state as

$$\Delta F^\circ_{298} = 19{,}884 \qquad \Delta H^\circ_{298} = 27{,}334 \quad \text{and} \quad \Delta S^\circ_{298} = 25{\cdot}0$$

as against the values given in the original paper[2]

$$\Delta F^\circ_{298} = 20{,}015 \qquad \Delta H^\circ_{298} = 27{,}342 \quad \text{and} \quad \Delta S^\circ_{298} = 24{\cdot}6.$$

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STUDIES IN ANTIMALARIALS—SOME SULPHA-BIGUANIDE DERIVATIVES

AMONG sulphanilamides[1-3] sulphadiazine is the most effective and possesses a slight but definite prophylactic action[4] in malaria. Metachloridine,[3] a recent suppressive antimalarial drug of the sulpha-group, is also a pyrimidine derivative.

Considering the activity of sulphadiazine, Curd and Rose[5] prepared at first its sulphur-free analogues of phenyl-substituted pyramidine type and their later work culminated in the discovery of paludrine,[5,7] which is a substituted biguanide derivative.

Compounds of the type (I) have not shown appreciable antimalarial activity[6] which might be partly due to lack of any potential substituent in the aromatic nucleus at N^5-position of the biguanide molecule. Hence it was thought of interest to prepare compounds of type (II) where "SO_2NH_2" or substituted "SO_2NH_2" radical is introduced in the aromatic nucleus at N^5-position, and for this purpose only potent sulpha compounds, sulphanilamide, sulphathiazole and sulphadiazine were selected. It may be mentioned that compounds of the type (III) have already been patented[8,9] as therapeutic agents.

$$\underset{1}{R\cdot C_6H_4\cdot NH\cdot}\underset{2}{C(=NH)\cdot}\underset{3}{NH\cdot}\underset{4}{C(=NH)\cdot}\underset{5}{NH\cdot R'HCl} \qquad \ldots\ (I)$$

R = alkyl, halo, nitro. etc. R′ = phenyl or naphthyl

$$p\text{-}R\cdot C_6H_4\cdot NH\cdot C(=NH)\cdot NH\cdot C(=NH)\cdot NH\cdot C_6H_4\cdot SO_2NHX\cdot HCl \qquad \ldots\ (II)$$

(*a*) X = H and R = H, m.p. 228°; R = Cl, m.p. 233°; R = Br, m.p. 245–6°; R = NO_2, m.p. 217°; R = CH_3, m.p. 231°; R = CH_3O, m.p. 234°.

(*b*) X = 2-thiazolyl and R = H, m.p. 225°; R = Cl, m.p. 219°; R = Br, m.p. 197° (with

decomp.); R=NO_2, m.p. 267°; R=CH_3, m.p. 189–190° (with decomp.); R=CH_3O, m.p 176° (with decomp.).

(c) X=2-pyrimidyl and R=H, m.p. 238°; R=Cl, m.p. 189°; R=Br, m.p. 202°; R=NO_2, m.p. 246°; R=CH_3, m.p. 232° (with decomp.); R=CH_3O, m.p. 210–212° (with decomp.)

$$R\cdot C_6H_4\cdot SO_2NH\cdot C(=NH)\cdot NH\cdot C(=NH)\cdot NHR' \quad \text{(III)}$$

R=NO_2, AcNH, NH_2, etc. R'=H, alkyl or aryl.

The eighteen new compounds indicated above have been synthesised by the interaction of the hydrochloride of the required sulpha-derivative and the corresponding para-substituted-phenylcyanoguanidine in boiling aqueous dioxan medium. The compounds were obtained as their hydrochloride salts and crystallised from dilute alcohol or water. The substituted phenylcyanoguanidines were obtained after denitrogenating the corresponding substituted phenylazocyanoguanidines and the report of a systematic study of the denitrogenation of similar triazines will be communicated later. These compounds which are fairly soluble in water and bitter in taste are being tested against bird malaria (*P. gallanaceum*) for their activity as antimalarials.

Further work on substituted biguanides as possible antimalarials is in progress. Full paper will be published elsewhere.

One of the authors (H. L. Bami) wishes to thank the Indian Research Fund Association for the award of a research fellowship which enabled him to undertake this work.

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RENNET COAGULATION OF VEGETABLE MILKS

THE *in vivo* digestibility coefficients of soya and groundnut protein as present in their milks have been shown to be 92 and 95 respectively as compared with 93 of cow milk protein.[1] In contrast with this, even high doses of animal rennet failed to coagulate the vegetable milks. This occurred in spite of raising the low (30 mg./100 c.c. of milk) calcium content of vegetable milks to the level of that of cow milk (120 mg./100 c.c. milk). Addition of soya milk to cow milk progressively retarded coagulation by animal rennet, curdling of cow milk being altogether inhibited above 100 per cent. addition. The corresponding dilution of cow milk with water retarded the rate of coagulation but did not altogether inhibit it. The peculiar property of the vegetable milks is not due to the thermolabile inhibiting factor reported by Tauber,[2] as the preparations used in our experiments were processed products obtained after prolonged boiling.[3]

In contradistinction to the activity of the animal rennet, we find that vegetable rennets from different sources and, particularly the one from the latex of *Ficus carica*,[4] coagulate both animal and vegetable milks with equal facility. This difference in the activities of the two groups of rennetic enzymes is under study.

The mechanism of digestion of vegetable milks in the animal body is still comparatively obscure. Attention[5] has already been drawn to the wide disparity between the *in vitro* and the *in vivo* digestibilities of soya milk. There is increasing volume of literature[6–11] on the nature and properties of the trypsin-inhibitor of soya-beans. We have found that the trypsin inhibitor has no inhibiting action on rennetic activity.

The foregoing observations would show that the digestion of vegetable milks in the animal body follows a different course from that of the animal milk. The ultimate results, as represented by utilisation in the animal body, seem, however, to be the same. Further studies designed to throw fresh light on the mechanism of digestion are in progress.

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August 13, 1947.

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AMMONOLYSIS OF ALIPHATIC KETONES WITH HYDROGENATION

DURING the course of our studies in the synthesis of compounds allied to paludrine[1,2,3] considerable difficulty was met with in preparing isopropylamine, one of the necessary intermediates. In our early experiments this was prepared by both Gabriel's[4] and Hoffman's[5] methods which were tedious and lengthy.

Direct ammonolysis of acetone with hydrogenation was a feasible approach which was

TABLE I
Preparation of aliphatic amines from Ketones

	Ketone	Corresponding amine	B.P. C°/685 mm.	Yield %
1	Acetone	Isopropylamine $CH_3CH(NH_2)\cdot CH_3$	32-34	91
2	Methyl ethyl ketone	2-Aminobutane $C_2H_5CH(NH_2)\cdot CH_3$	60-62	87
3	Diethyl-ketone	3-Aminopentane $C_2H_5CH(NH_2)\cdot C_2H_5$	84-86	75
4	Methyl-*n*-propylketone	2-Aminopentane $CH_3CH(NH_2)CH_2C_2H_5$	88-89	87
5	Methyl-isobutylketone	β-Isohexylamine $CH_3CH(NH_2)\cdot CH_2\cdot CH(CH_3)_2$	99-102	80
6	Methyl-*n*-amylketone	2-Aminoheptane $CH_3\cdot CH(NH_2)\cdot (CH_2)_4\cdot CH_3$	136-138	46
7	Methyl-*n*-hexylketone	2-Aminooctane $CH_3\cdot CH(NH_2)\cdot (CH_2)_5CH_3$	164-165	60

tried later on with very encouraging results. Acetone was converted into isopropylamine in good yields by using aqueous or alcoholic ammonia in excess with hydrogen under a pressure of 100 lbs./sq. in. and at a temperature of 50-60° C. in presence of Raney's nickel as catalyst (5-10 per cent.).

A number of other aliphatic ketones were used in the synthesis of the corresponding aliphatic amines (Table I). In the case of water-immiscible ketones, solvents, higher temperature and longer period of reaction were necessary. Amines were isolated from the reaction mixture as their hydrochloride salts, regenerated with alkali and purified by repeated distillation. In all the experiments the primary amines were the main products, and only negligible amounts of secondary or tertiary amines were obtained.

The mechanism of the reaction has been explained by Loffler[6] and Magnonic.[7] The present series of experiments indicate that this method is of general applicability for converting aliphatic ketones into corresponding amines.

Details of this work will be published elsewhere.

One of the authors (H. L. Bami) wishes to thank the Indian Research Fund Association for the award of a research fellowship which enabled him to undertake this work.

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PHENOLPHTHALEIN AS ADSORPTION INDICATOR IN ARGENTOMETRIC TITRATIONS

IN a recent communication[1] the applicability of resorcinol-succinein as adsorption indicator has been described. I find that phenolphthalein is adsorbed to an appreciable extent by the AgCl—Ag^+ system, and can be used as an adsorption indicator for titrations of chloride ions against silver ions at a pH of 8-10. In this range it gives on adsorption a definite pink colour to the silver chloride particles.

For the practical application of the indicator, a drop of 0·2 per cent. phenolphthalein is added to 10 c.c. of potassium chloride (about N/10) solution. A drop or two of dilute ammonia is now added until the solution assumes a slight pink colour. Silver nitrate is now run in, and as soon as the equivalent amount of silver nitrate has been added, just a drop of the titrating solution in excess causes the coagulation of silver chloride which separates out as a definitely bright pink mass leaving the supernatant solution colourless.

Quantitative measurements on the adsorption of phenolphthalein by the neutral and positively charged silver chloride bodies will be published in detail elsewhere.

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ON THE OCCURRENCE OF PROTOZOA IN LAND-FILTERED SEWAGE EFFLUENT

IT has been shown that certain ciliate protozoa, particularly Vorticellids, are of special significance in the Activated Sludge Process and other artificial systems of sewage purification, and that these protozoa in the sewage tanks are originally derived from soil.[1-10] Further observations carried out during the last four years at

Madura (South India) have shown that these protozoa naturally develop in large numbers in the land-filtered sewage effluent and from an important link in the chain of life processes in the medium. The practice of land-filtration of sewage and the soil conditions at Madura, the mode of development of the protozoa in the effluent and related aspects are briefly described below.

Madura has now a population of about three and a half lakhs, and the sewage from more than half the population is discharged into the municipal sewers. The daily discharge of sewage from this population is about three million gallons, including a comparatively small quantity of liquid waste from the textile mills. About two million gallons of this volume of sewage is daily filtered, without any pre-treatment, on an area of about 113 acres of gently sloping land in the neighbourhood of the city. The soil is fairly porous and the efficiency of the soil drainage is maintained by having underdrains and also by periodically removing the sewage matter accumulating on the soil surface.[11] The underdrains consist of earthen pipes loosely jointed and laid in rows at a depth of 3 to 4 feet, the distance between two rows of pipes being about 33 feet. The bulk of the land-filtered liquid, which is fairly clear, flows down through these pipes into a specially constructed effluent channel. The effluent from this channel (the quality of the effluent generally conforms to the Royal Commission Standard) is finally utilised along with irrigation water for agricultural purposes. The land filtering the raw sewage is also cultivated and the principal crop grown is guinea grass which yields very well (about 120 tons per acre per year).

On either side of the effluent channel, as also attached to certain green algæ, may be seen large whitish fluffy masses of Vorticellids which are composed of a number of species of *Carchesium* and a few species of *Epistylis*. The dominating forms are the species of *Carchesium* and one of the commoner species is *Carchesium epistylis* Cl. & L. (Figs. 1 and 2). Species of the simple *Vorticella* and other ciliate protozoa, such as *Paramœcium*, also occur in the effluent. Along with the protozoa, worms, insect larvæ, especially those of *Chironomus* sp., prawns, crabs, gastropods, frogs, fish and other forms also flourish.[11]

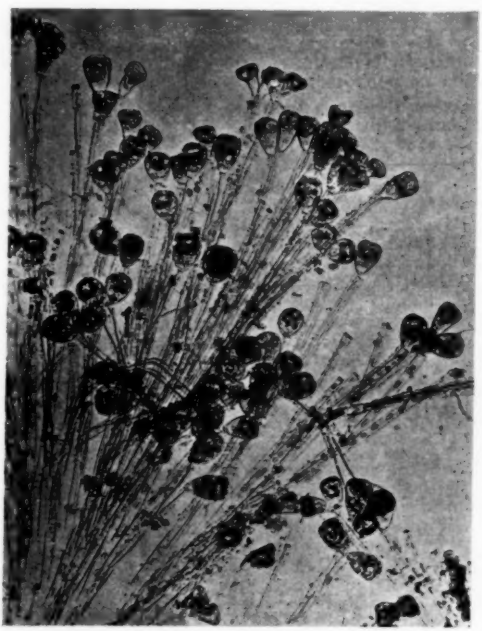

FIG. 1. Photomicrograph of a Colony of *Carchesium epistylis* Cl. and L. occurring in the land filtered sewage effluent at Madura. × 75.

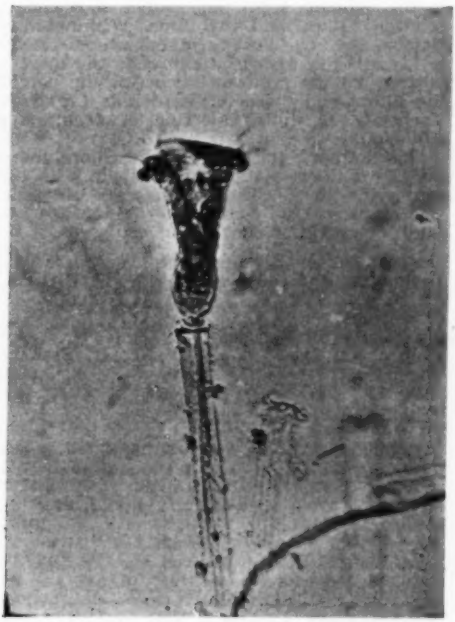

FIG. 2. An individual of *C. epistylis* Cl. and L. enlarged × 350.

The protozoa and other fauna develop in large numbers in the effluent in all seasons of the year unless sewage irrigation is stopped for unduly long periods, as under the conditions of excessive and continual rains, when they slowly disappear; but when the sewage application is resumed, the fauna also gradually develop. Thus during October-December 1946, when sewage irrigation was stopped due to unusually heavy rains, from 30th October to 20th November and again from 30th November to 19th December, the protozoal growths and other fauna, particularly the fish, were largely absent from the effluent, but reappeared when sewage irrigation was continued.

We have made a similar observation in regard to the development of protozoa in the Activated Sludge tank, *viz.*, if aeration of sewage is continued without any fresh supply of raw sewage, the protozoa cease to multiply and become inactive and eventually disappear, presumably because of the lack of nutrients from raw sewage. In this connection it is of special interest to observe that examination of activated sludge from the purification plant at Bangalore over a period of several years has not revealed the presence of any species of *Carchesium*, while there is always a preponderance of *Carchesium* sp. in the land-filtered sewage effluent at Madura. The significance of this observation is still under study.

The occurrence of *Carchesium lachmanni* in oxidising filters was reported many years ago by Boyce.[12] Fowler[13] observed this protozoan in the effluents from the contact beds and percolating filters at Davyhulme, Withington and Gorton Sewage Works (Manchester). Recently Lloyd[14] has drawn attention to the more important ciliate protozoa occurring in percolating filters and these forms include *Carchesium, Vorticella, Epistylis, Opercularia, Aspidisca* and *Chilodon*.

The authors thank Prof. V. Subrahmanyan and Dr. Gilbert J. Fowler for their keen interest in the work. Their thanks are also due to the Municipal authorities at Madura for their kind co-operation in the investigation.

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TAMARIND SEED POLYSACCHARIDE

DIVERSE views have been expressed regarding the classification of the polysaccharide of the tamarind seed kernel,[1,2,3] leading to confusion in the name of the substance.

The polysaccharide possesses the characteristic property of forming acid-sugar-jellies just like the fruit pectins. Unlike the latter, however, it is not derived from polygalacturonic acid; but it is a carbohydrate composed of xylose, glucose and galactose.[4] Further, it is capable of forming jellies under varying conditions of pH including neutrality.[5,6] It does not, therefore, strictly come under the class of pectins,[3,5] as defined in the Report of the American Chemical Society on Pectin Nomenclature.[7] Hence it is desirable, as already pointed out elsewhere,[8] either to enlarge the accepted definition of the word pectin so as to include substances of the type of the tamarind-seed product or to coin a new term to designate them. If the latter alternative were adopted, it would be desirable to choose such a term as would indicate not only the chemical nature of these substances, but also, if possible, their most important characteristic phyical properties. On the basis of these criteria, the name 'polyose' or 'hexopentosan', suggested by Savur and Sreenivasan,[3] does not seem to be satisfactory. The term "Jellose" appears to be suitable inasmuch as it indicates both the carbohydrate nature and the jelly-forming property of the substance. Jelloses, like pectins, gums and mucilages, may form a new group amongst the carbohydrates.

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WILT DISEASE OF GUAVA (*PSIDIUM GUYAVA* L.)

FOR the last few years a very high rate of wilting of guava plants has been observed in certain orchards in Lucknow. The result of the initial survey of orchards in and round about Lucknow and in certain districts of the U.P. showed that the disease is fast becoming a menace to the orchard owners. The problem was, therefore, taken up for pathological investigations.

In order to find out the time of incidence of the disease and the rate at which it advances, the guava trees of the Government Horticultural Garden were kept under careful observation during the year 1945 and 1946. The highest rate of wilting has been observed during the rainy season. The disease starts in August with the largest number of deaths in September and October. In November there is a marked decrease in the number of trees wilting, and with advancing winter the disease comes almost to a standstill (Fig. 1).

The symptoms are more or less same as described for the wilts in general for higher vascular plants. The first external symptom was yellow colouration of the leaves of terminal branch, which was followed by the drying of that particular branch. Simultaneously other

branches also wilted. Usually it took from ten to fifteen days for the complete wilting of the tree. An examination of the finer roots showed that some of them had black streaks which became more prominent on removing the bark, while others were black uniformly.

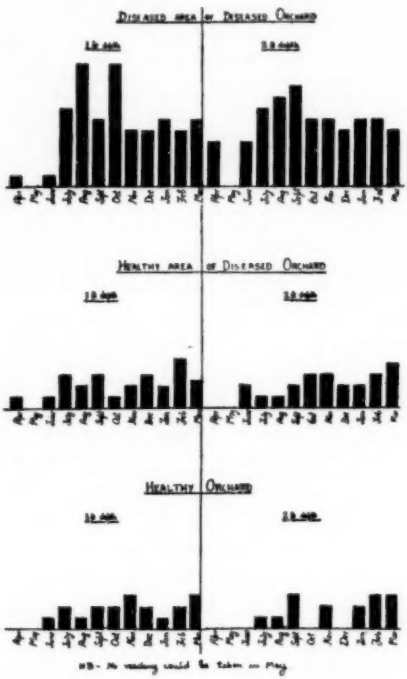

FIG. 1

The nature of the disease indicated that it was due to root infection. Nevertheless isolations were made from different parts of root and shoot of diseased trees along with those of the healthy trees from the same orchard. The result of the isolation showed prevalence of *Fusarium* in the root system and the lower part of the shoot of the diseased tree, the upper part having certain other fungi. In very few cases a non-sporulating fungus was found associated with *Fusarium*.

The isolation experiments gave a strong indication that *Fusarium* was the cause of the wilt. Pathogenic tests were, therefore, carried out using monohyphal culture of the fungus on guava seedlings, one month, three months, one year and three years old. All the inoculation experiments were made in potted plants, to the soil of which the *Fusarium* culture was mixed in a definite proportion.

The following table gives a summarised result of root inoculation with seedlings of different ages.

Treatment	Age of seedling	Average % of wilt
Inoculated ..	1 month	86·3
Control ..	1 month	nil
Inoculated ..	3 months	100
Control ..	3 months	nil
Inoculated ..	1 year	83
Control ..	1 year	nil
Inoculated ..	3 years	80
Control ..	3 years	nil

After the seedlings had wilted, an effort was made to reisolate the fungus from roots, and almost in every case the fungus inoculated was obtained.

Shoot and foliage inoculation was also tried by spraying the fungus dilution with an atomizer, and putting the inoculum on injured and uninjured surface of the leaves and stem but with no result.

For the purpose of correlation, a study of the soil microflora of the infected orchard during various months of the year was undertaken. The dilution plate method was employed for this study. Apart from several other Fungi and Bacteria that were obtained, a marked variation was found in the number of *Fusarium* colonies appearing during various seasons. The accompanying figure will give an idea of the distribution of *Fusarium* during different months of the year.

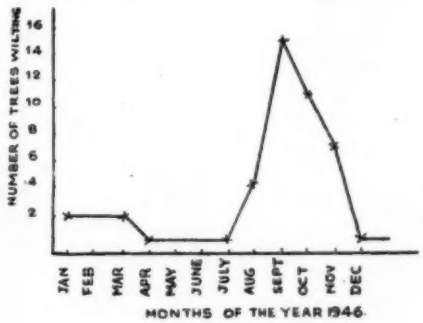

FIG. 2

Having established the pathogenicity of the Fungus, a study of the mechanism and physiology of wilt was undertaken. The work is still in progress, but the results so far obtained show that the fungus grown in liquid medium (Richard's solution) produces some toxic substance which causes wilt in the guava plants. Seedlings transferred to these solutions die readily. In twenty days' old culture solution, freed from the fungal growth by Seitz filter, the first symptom of wilt in one-year old seedlings was observed about 3 hours after their transference, and within 10 to 12 hours they

were completely wilted. Seedlings kept in Richard's solution (uninoculated) as control remained unaffected.

The detailed paper will be published shortly.

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June 25, 1947.

THE NEST OF A RESIN-WORKING SOLITARY WASP

A wasp nest built entirely of resinous substance was noticed on the door of a bath-room at Namkum, Ranchi. The nest consisted of eight round and about thirty oval cells. The round cells, with circular openings, were semi-elliptical in section, 12-13 mm. in diameter and 9-10 mm. deep. The oval cells were 13-14 mm. long and 5-6 mm. broad. The rough surface of the cells were made up of lumps of resin, mostly of hard pale yellow and some soft brown, arranged in concentric rings. The cells, on breaking, smelt strongly of gum benzoin. The walls of the cells were quite hard and brittle, and found varnished with a whitish glistening substance, probably secreted by the wasp grub before pupation. The nest resembled that of the typical 'mud-dauber' or 'potter', and probably was constructed by one of the Eumenid wasps.

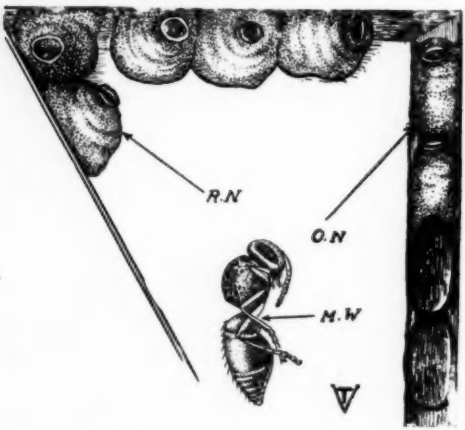


Fig. 1. Showing resin wasp nests on door (nat. size) R. N.—round brood cells; O.N.—oval brood cells; M.W. – Mutillid wasp, female, × 3.

All the cells except four with dead adults of a species of Mutillid wasp (*Mutilla* sp.), were empty. The female Mutillid is wingless; head and thorax black and coarsely rugose; ocelli wanting; abdomen with black pubescence; the lower margins of first and second abdominal segments with narrow transverse bands of glittering golden hairs. The male is winged; ocelli present, three in number on vertex; mandibles slightly bent and tridentate; patches of golden hairs present on head and thorax in addition to bands on abdomen. The Mutillid wasps are probably parasitic on the immature stage of the Eumenid wasp which build the resin nest. The majority of species of Mutillid wasps are found parasitic on *Aculeata hymenoptera*; Maxwell-Lefroy[1] has recorded more than one species of *Mutilla* parasitic on Eumenid wasps in India. Some of the empty cells contained remnants of caterpillars; apparently caterpillars were used as prey by the Eumenid grubs.

Little is known of the nesting habits of resin-gathering wasps in India. Maxwell-Lefroy mentions a Eumenid (*Rhynchium nitidulum* Fabr.) which makes a cluster of oval cells coated with a black gummy substance. Phil Rau,[2] in a recent paper on Mexican solitary and social Bees, states that the Megachilid Bees use resin only for plugs for the doorways and partitions within the cells of old nests of paper wasps.

The resinous substance is probably composed of resin and bark scrapings of plants chewed together and mixed with the saliva of the wasp. Seven grams of the yellow resin from thirty cells were analysed.

Cold water has no effect on the resin. The extract with boiling water is pale greenish yellow. The extract did not reduce Fehling's solution, indicating the absence of reducing sugar. Boiling 95 per cent. alcohol extracts 86·6 per cent. of the resin. The alcoholic solution is acidic to litmus, evolves CO_2 from sodium bicarbonate solution and leaves a hard discontinuous film on evaporation. On dilution with water a colloidal solution is formed, from which the resin could be separated by the addition of an electrolyte like NaCl. This method was used to purify the resin.

Characteristics of the yellow resin from wasp nest

Softening point	96°–102° C.
Melting point	105°–120° C.
Acid value	39·3
Saponification value	80·17
Ash %	0·44

The alcohol-insoluble part consisted of a small quantity of fibrous material, white granular substance and some dust particles. This softened at 150° C., but did not melt properly. On ignition it left a white ash.

Destructive distillation of the resin yielded 47·5 per cent. of the resin as an oil with strong smell of gum benzoin, and refractive index, 1·502.

T. V. Venkatraman.
T. Bhowmik.
Indian Lac Research Institute,
Namkum, Ranchi (Bihar),
April 25, 1947.

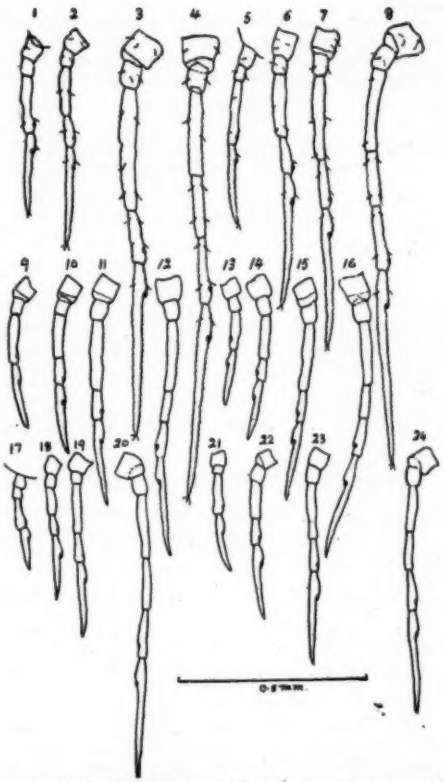
1. Maxwell Lefroy, H., *Indian Insect Life*, 1909, 187, 212. 2. Phil Rau, *Ann. Ent. Soc. Amer.*, 1943, **36**, 641.

POST-EMBRYONIC DEVELOPMENT OF ANTENNA IN APHIDS

During the course of my study of the various nymphal stages of Aphids, I found that Saxena's[1] observations regarding the mode of post-embryonic development of antennæ of insects in general and *Bagrada picta* Fabre in particular are not in conformity with those of Fuller,[2] Bugnion[3] and Quadri.[4] Studies both

on the alate and apterous viviparous forms of the three species of aphids, *viz.*, *Aphis gossypii* Glover, *Rhopalosiphum pseudobrassicæ* Davis, and *Aphis nerii* Fonscolombe show that the mode of development of the antennæ is more or less similar in all these forms.

In the adult insect each antenna is six-jointed, mobile, filiform and beset with spines. A primary sensorium is situated on the top of the penultimate and another at the base of the ultimate segment, while the secondary sensoria are distributed from the third to sixth segments. The scape is the smallest and the ultimate segment, the longest.



FIGS. 1–8. Antennæ of the nymphal stages of Alate and Apterous vivparous females of *Aphis nerii* Fous. FIGS. 9–16. Antennæ of the nymphal stages of Alate and Apterous viviparous females of *R. pseudobrassicæ* Davis. FIGS. 17–24. Antennæ of the nymphal stages of Alate and Apterous viviparous females of *A. gossypii* G.

Just after hatching, the first stage nymph has four-jointed antenna. The scape and pedicel are nearly of equal length, while the fourth or the ultimate segment is the longest. The primary sensoria are present, one at the distal end of the third segment, the other at the base of the fourth. A constriction then begins to appear in the third antennal segment.

After the first moult the antenna elongates slightly. The scape and pedicel remain nearly of equal length. The constriction which started in the third segment of the first stage nymph becomes very clear, dividing the segment into proximal and distal portions, the former being longer than the latter. The antenna is now five-jointed, the ultimate segment being the longest. The primary sensoria in this stage are situated on the top of the distal portion of the third segment, which may be called the fourth segment and at the base of the ultimate segment, which now becomes the fifth segment.

The antenna in the third stage nymph elongates further, having five segments, the last being the longest. The primary sensoria are situated on the top of the fourth and at the base of the fifth segment indicating that these are respectively the future fifth and sixth segments of the adult. The third segment also increases in length, and a constriction again appears in it.

In the fourth stage nymph the antenna continues to elongate. The pedicel becomes slightly longer than the scape. The constriction which had started in the third segment of the previous stage divides the segment into two parts, the proximal portion being longer than the distal, making the antenna now six-jointed. The primary sensoria are situated on the same segments as in the last stage, the segment now being the fifth and sixth.

It is concluded that the pedicel does not divide in Aphididæ. In this family the post-pedicel elongates and becomes three-segmented by two successive divisions which take place in the second and fourth nymphal stages. These observations agree with those of previous workers[2–4] except of Saxena.[1]

I wish to record my thanks to Dr. Rakshapal, Lucknow University, for his valuable suggestions and correction of the manuscript for the press.

Entomologist,
Gwalior, C. B. L. BHARGAVA.
June 23, 1947.

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METABOLISM OF UNSTRIATED MUSCLE

STUDIES of the activity of frog's stomach muscle have shown that there are separate metabolic mechanisms for the production of mechanical activity under different conditions.

1. *Activity under anærobic conditions.*—The excitability of the muscle to alternating current (10 volts for 10 seconds every 1 minute), after a variable latent period, is at first increased and then depressed, and finally the muscle may be completely paralysed, though partial activity continues for a long time in the absence of oxygen. During this steady state, if oxygen is admitted, there is at first a depression before the response returns to normal; this depression may amount to complete paralysis—oxygen paralysis. These experiments suggest two mechanisms—for ærobic and anærobic conditions—in unstriated muscle, and

these two are mutually exclusive; this, in fact, is a Pasteur reaction.[1]

2. *Activity in acid solutions.*—Unstriated muscle may become hyperexcitable in acid solutions (pH 6·5). In alkaline solutions, glucose has a beneficial effect, but this becomes less marked in acid solutions. As a matter of fact, in acid solutions, pH 6·5, the effect of glucose may be inhibitory. This differential effect of glucose suggests that there are different metabolic mechanisms in alkaline and acid solutions respectively.

3. *Tonic and twitch contractions.*—If by repeated stimulation in the absence of oxygen, the muscle becomes fatigued to alternating current, the addition of potassium ion (20 per cent. of the sodium of the saline replaced with potassium), produces a powerful contraction, and the excitability to alternating current also greatly increases, so that the asphyxial paralysis is abolished. This effect is produced by all substances that produce tonic contraction. These experiments suggest that there are different metabolic mechanisms for tonic and twitch contractions but the energy released by the former is utilisable by the latter.

4. *Tonus.*—Oxygen consumption experiments have shown that there are two kinds of tonic contractions, one that uses oxygen and the other that does not.[2,3] This has been confirmed by the finding that there are two kinds of tonic contractions, one that decreases and the other that increases in the absence of oxygen. As a matter of fact, it is possible for unstriated muscle to maintain considerable tension for several hours in the absence of oxygen and die in the contracted state; this tonic contraction appears to be identical with asphyxial rigor in striated muscle. One kind of tonic contraction of unstriated muscle appears to be identical with contracture of striated muscle; this uses oxygen. The other kind of tonic contraction, which does not use oxygen, appears to be related to rigor mortis of striated muscle. Contractions of striated and unstriated muscles are thus closely related.

INDERJIT SINGH.
MRS. SUNITA INDERJIT SINGH.

Physiological Laboratory,
Dow Medical College,
Karachi,
June 9, 1947

1. Lipmann, F., *A Symposium on respiratory enzymes.* The University of Wisconsin Press Madison, p. 48. 2. Rao, M. S., and Singh, I., *J. Physiol.* 1940, **98**, 12. 3. Singh, I. and Mrs. Singh, S. I., *Proc. Ind. Acad. Sci.*, 1947, **23**, 312.

EFFECT OF DIFFERENT NUMBER OF TILLERS ON THE QUALITY OF PRIMARY (*MOTHER*) SHOOT IN SUGARCANE

PRIMARY (mother) shoot in sugarcane is already known to be of superior quality than its tillers.[1,2] The effect of different numbers of tillers on the mother-shoot is, however, not fully known. Experiments in this direction were carried out at the Main Sugarcane Research Station, Shahjahanpur, during 1943-44 and 1945-46 with Co. 527 and CoS. 146 respectively. Five hundred primary shoots were tagged in the February-planted crop during the month of April. Subsequent tillers were labelled as they emerged. The primary shoots (A to D) were divided according to the number of tillers, 0 to 3, with the plants into 4 treatments.

Tillers that followed above the quota of the respective treatments were cut out every week, and only plants that acquired their treatmental quota of tillers by the middle of July were selected.

The different kinds of primaries and tillers were examined for juice quality during the crushing season with 10 canes coming from 10 different plants for each sample.

TABLE I

Showing quality of different kinds of primaries and their secondary shoots

Treatments	Co. 527(1943–44)		CoS.146 (1945–46)	
	Sucrose %	Purity	Sucrose %	Purity
A-Primary shoots	13·38	79·78	19·70	89·32
B-Primary shoots with 1 tiller	14·51	84·01	20·45	89·58
1. Primary shoots				
2. 1st tiller ..	14·19	81·68	19·88	88·02
C-Primary shoots with 2 tillers				
1. Primary shoots	14·65	84·80	20·53	90·59
2. 1st tiller ..	14·05	80·88	20·14	89·50
3. 2nd tiller ..	12·86	78·55	19·98	89·08
D-Primary shoots with 3 tillers				
1. Primary shoots	..	..	20·69	90·07
2. 1st tiller ..	..	..	20·54	89·97
3. 2nd tiller ..	..	..	20·40	89·35
4. 3rd tiller ..	..	..	19·84	89·35

The above data not only further confirm the view that the primary shoot is superior in quality than its tillers, but also make it clear that the larger the number of tillers the better the quality of the primary shoot.

My thanks are due to Dr. A. K. Mitra for his valuable help in planning this experiment, and to the Indian Central Sugarcane Committee for financial assistance.

Main Sugarcane Research Station,
Shahjahanpur, RAM KRISHNA.
June 30, 1947.

1. Panje, R. R., *Proc. Sugar Tech. Assoc.*, 1943, 12th convention. 2. Rodrigues, H. J., *Planter and Sug. Mfr.*, 1928, **80**, 101.

REVIEWS

Methods of Mathematical Physics. By H. and B. S. Jeffreys. (Cambridge University Press), 1946. Pp. 679 + vii. Price 63 *sh.*

Although there are books in other languages, particularly in German, designed specifically to meet the mathematical needs of physicists, there has been so far no such treatise in English, covering broadly the various branches of pure mathematics that are often required in problems in advanced physics. The book under review is intended to fill this gap. An idea of the scope of the book may be gathered from the following table of contents: 1. The Real Variable, 2. Scalars and Vectors, (3. Tensors, 4. Matrices, 5. Multiple Integrals, 6. Potential Theory, 7. Operational Methods, 8. Physical Applications of the Operational Method, 9. Numerical Methods, 10. Calculus of Variations, 11. Functions of a Complex Variable, 12. Contour Integration and Bromwich's Integral, 13. Conformal Representation, 14. Fourier's Theorem, 15. The Factorial and Related Functions, 16. Solution of Linear Differential Equations of the Second Order, 17. Asymptotic Expansions, 18. The Equations of Potential Waves, and Heat Conduction, 19. Waves in One Dimension and Waves with Spherical Symmetry, 20. Conduction of Heat in One and Three Dimensions, 21. Bessel Functions, 22. Applications of Bessel Functions, 23. The Confluent Hypergeometric Function, 24. Legendre Functions and Associated Functions and 25. Elliptic Functions.

The senior author of the book has already published a tract on "Operational Methods in Mathematical Physics," which did useful service in reviving interest in Heaviside's methods in recent years. Much of the matter contained in that book finds a place in the present work, particularly in Chapters 7 and 8. In fact, a notable feature of the book is the systematic application of operational methods for solving the differential equations that occur in the various problems, and even in the treatment of standard cases such as Bessel's equation. The addition of the first chapter on the theory of functions of the real variable has increased considerably the clarity and rigour of the later sections. The book contains numerous applications of the methods developed to problems in physics, particularly in potential theory, dynamics, electromagnetism, heat conduction, wave motion, etc. There is, however, comparatively little reference to applications in modern physics, such as relativity theory and quantum mechanics. For instance, the chapter on tensors does not contain even an introduction to the absolute differential calculus. It is felt that the addition of a few more pages dealing with some ideas of differential geometry and of group theory and subjects allied to them such as tensor calculus, theory of transformations and modern algebra would make the book more complete and useful to students of modern theoretical physics.

On the other hand, the book covers quite a large field of mathematics and contains many things that one would not normally expect in a work of this type. One such, as already mentioned, is the detailed treatment of operational methods. Another is a brilliant chapter on numerical methods, which would be of great help in the usual computations accompanying theoretical investigations. The chapter contains practically all the salient details of this subject in the brief space of 50 pages. Most of the higher functions that occur in mathematical physics, such as the factorial, Bessel, hypergeometric, elliptic, Legendre, etc., are discussed in good detail. In this, the authors have boldly used new definitions of the various functions, so as to secure greater symmetry in the expressions, as also simpler relations between different functions.

The following errors and misprints may be noted: (1) In p. 18, it is stated, "It is a matter of definition whether we say that $f'(x)$ does or does not exist when $\{f(x+h)-f(x)\}/h \to \infty$; we shall usually say that it does not." As contrasted with this, see p. 28, line 4, 'The derivative exists, but is unbounded'; (2) in the chapter on Legendre functions, it is never stated that μ stands for $\cos\theta$, although the relation is used throughout the chapter; (3) in p. 158, line 2, the Jacobian is inverted; (4) in p. 314, the definitions for closed and open intervals have been interchanged; (5) in p. 420, Eq. 12, the right-hand side should contain a factor $\frac{1}{2}\pi$. These, however, do not in any way detract from the merits of the book, which will be found to be a very useful reference book by all workers in theoretical physics. The printing and get-up are good and come up to the usual standards of the Cambridge University Press. The cost is perhaps a little beyond the means of individual students, which is unavoidable with a book of this size. The reviewer, however, warmly recommends the book to every library in advanced physics.

G. N. RAMACHANDRAN.

A Practical Course in Agricultural Chemistry. By F. Knowles and J. E. Watkin. Second Edition. (Macmillan & Co.), 1947. Pp. 216. Price 12/6d. net.

The present publication is the second edition of a book which first appeared in 1937. The authors, who are well known in the profession and long associated with teaching and research, have made extensive revisions so as to make the methods fairly up-to-date. The book is a useful compilation, and, apart from its value to the student going up for degree examination, it is also quite serviceable as a refresher to research workers and others who are not in a day-to-day touch with the various methods.

As stated by the authors in their preface, the book is mainly intended to give an outline of the various methods employed in soil science,

plant biochemistry, dairying, horticulture and poultry husbandry—all of which are studied for the degree course. The methods are naturally quite numerous and highly varied in character. The wide scope necessitates brevity in description, and although here and there even elementary principles are explained, the main text of the book would require a fairly good background of chemistry.

It is presumed that the selected methods are intended to be such as can be tried out in a laboratory with minimum equipment. The method of Walkley and Black recommended for the estimation of carbon has the advantage of ease and simplicity, but it cannot be regarded as accurate. Other methods, easily adaptable to laboratory conditions are also available. In some cases, the authors have stuck to some of the older methods, though others have, not only advocated but also found, some of the modified and newer methods to be more useful. Thus, although the previous moistening of the soil with water helps in the Kjeldahl digestion and yields consistently more dependable results (especially in the case of heavy soils), there is no reference to it. The Fiske-Subbarow method of colorimetric estimation of phosphorus has not been recommended though it is the most popular method for micro-quantities at the present time. The use of bismuthate for the estimation of manganese has not been cited. Similarly, there is no reference to the use of oxyquinoline for the estimation of some of the elements, especially aluminium. These are, of course, inevitable when the size of the book is restricted and the authors have to cater mainly to students who do Agricultural Chemistry as one among several subjects.

The book has been well written with a practical insight into the actual requirements of the users. Sir John Russell has paid a well-deserved compliment in his introduction to the book. The printing is excellent, in keeping with the high traditions of the publishers. The book will be found very useful by students of Agricultural Chemistry over different parts of the world. V. SUBRAHMANYAN.

Chemistry of Vitamins and Hormones. By S. Rangaswami and T. R. Seshadri. (Andhra University, Waltair, South India), 1946. Pp. 329. Price Rs. 7-8-0.

Biology and medicine are greatly indebted to the science of organic chemistry for the rapid advances which they have registered in their respective fields. The entire subject of vitamins and hormones is of so recent an origin and has progressed at such bewildering speed that it has become impossible for an interested worker to keep pace with all the important publications dealing with this subject. The discovery, isolation and synthesis of most of these substances have led to the widening of the scope of their application and have contributed to a better understanding of many biological processes.

Much of the credit for this goes to the organic chemist, for it was his tribe that made it possible to produce in large amounts these of the theory underlying the *Chakravala* prophysiologically active substances and also to find simpler, cheaper and sometimes more active substitutes prepared synthetically. From the point of view of budding organic chemists, this book is an admirable one. There are described the more important stages of earlier work on each vitamin and hormone. The descriptions of properties, structure and synthesis follow in each case where they are definitely known. The account dealing with physiological function and methods of assay is also well written. The book will be of immense use not only to the students taking their degrees with organic chemistry as special subject, but also to those investigators who need from time to time information of the kind found in the book, all in one place. V. N. P.

A Chapter in the Theory of Numbers. By L. J. Mordell. (Cambridge University Press), 1947. Pp. 31. Price 1/6*d*.

This forms the subject-matter of an inaugural lecture given at Cambridge by the author, and contains a historical review of the attempts at finding the integral as also rational solutions of the equation $y^2 + K = x^3$ and allied problems. Particular cases of K, like $K = 2$, $K = -17$, are famous problems, adaptable to elementary methods. The theory of algebraic numbers has greatly advanced our knowledge of the subject. The most general equation $y^2 = x^3 + K$ which has no rational solutions is a problem still awaiting solution. C. N. S.

Ancient Indian Mathematics and Vedha. By L. V. Gurjar. (Ideal Book Service, Sadashiv Peth, Poona). Pp. 202. Rs. 6-4 or 10 *sh*.

Books on the history of Ancient Indian Mathematics written in English or for the matter of that in any Indian language are so few that any new book brought out has its due place and use. Indian mathematicians and historians justly resent that the achievements of ancient Indian mathematicians are not given proper recognition in books on history written by Westerners. Several Western savants have done valuable service in translating or interpreting the writings of Aryabhata, Brahmagupta and Bhaskara. But how many books on the history of mathematics written in Europe and America refer to the value of $\pi = 3{\cdot}1416$ as first given by Aryabhata, or to Bhaskara's work on indeterminate equations, or to India's contribution to the algebra of combinations? The need for suitable books written by Indians themselves is thus manifest; but no useful purpose is served by one's crying from the house-top about the "glorious and profound researches" of ancient Indians, without presenting a succinct and scientific account of these researches. Mr. Gurjar's book is, from this point of view, disappointing. He would have better served his brief for the Indian cause, if he had set forth the mathematical justification of the more advanced results of the Indian scholars. For example, one would except in the book a comparative discussion of the methods of Aryabhata, Brahmagupta and Bhaskara with respect to *Kutlaka*, of the theory underlying the Chakravala process and so on. Even from the historical point of view, the book is not free from defects. Most of the geometry found in Aryabhata was known to the Jains of the pre-Christian era.

There is no mention at all about India's contribution to the theory of permutations and combinations, about Bhaskara's work pertaining to the notion of the differential calculus, and about Indian methematics after Bhaskara, especially of the Malabar school.

The author is well versed in Sanskrit, and is a Professor of Mathematics. We would earnestly suggest to him to rewrite this book, or to write a bigger book, with less of superlatives but with more of mathematics.

C. N. S.

The Methods of Cellulose Chemistry. By Charles Dorée. Second Edition (revised and enlarged). (Chapman and Hall Ltd., 37, Essex Street, London, W.C. 2), 1947. Pp. 543. Price 42 *sh.*

The experimental investigator has always felt the need of a handy book giving full experimental details of specialised methods for the study of Cellulose in its various aspects as a primary constituent of plant cell, as a chemical entity and as a structural colloidal unit. In the preparation of this edition, Dr. Dorée has admirably succeeded in this task of providing "full working details of a selection of the subject". The material is grouped under three sections dealing with normal cellulose, its synthetic derivatives and compound celluloses. It is hoped that this edition will be readily welcomed by the student who is undertaking research in the extensive field covered by cellulose and the natural constituents associated with it in the plant world, as well as by the workers in commercial laboratories controlling and investigating the manufacture of cellulose products.

The technique associated with X-ray investigation of cellulose has, however, been omitted. It could have been included with advantage at least in this edition, as Röntgen's graphic methods of investigation of natural products are finding favour even in this country.

P. L. N. Rao.

Journal of the History of Medicine and Allied Sciences, Vol. 1, No. 1. (Henry Schuman, New York), 1946. Price $8.50 per year.

This quarterly is devoted to the publication of work relating to all aspects of the history of medicine, public health, dentistry, nursing, pharmacy, veterinary medicine and allied sciences which impinge on medicine. The first number of this new venture is prefaced by an interesting article arrestingly entitled, "What is past, is prologue", contributed by Editor Rosen, who has emphasised the importance and value of history as one of the most powerful driving forces in human development. In the solution of difficult and intriguing problems which confront us, the historical approach often facilitates solution. A knowledge of not only the past achievements but also the mental processes, the ideological and philosophical conflicts which inspired the action and economic and political background against which the event was enacted is helpful for envisaging and planning a rationalised future. "Without sound historical knowledge, men act instinctively and emotionally but not rationally."

According to the Editor, medical history is to be cultivated not "as a mere search for antiquities, as a kind hunt for curios, but rather as a vital, integral part of medicine.

The number under review contains 11 contributions including the prefatory prologue to which reference has already been made. Personal reminiscences and achievements of some of the old world pioneers of medicine and pharmacy, medical education in the 17th century England, incubator and taboo, animal substances in materia medica, are some of the subjects discussed in the number. An interesting and perhaps an unusual feature of the journal is the "Notes and Queries" which is included to "provide a medium of communication between readers with unsolved problems and readers who can solve them". Book reviews and notes on contributors are the other features of the journal. The enterprise is supported by a panel of consulting Editors representing different interests and different parts of the world. India and China possess a rich tradition in medicine, and the international status of the journal would be raised by inviting representatives of these two countries to join the panel. The journal will no doubt be widely welcomed not only by the ever-expanding circle of the medical profession but also by historians of science. We wish the journal a long and purposeful career.

M. S.

The New Genetics in the Soviet Union. By P. S. Hudson and R. H. Richens. (Imperial Bureau of Plant Breeding and Genetics.)

The history of development of genetics during the first thirty years of the present century was marked by a general uniformity in the fundamental conceptions of the science in all countries including Russia. About the year 1930, however, there sprang up in Russia a new school headed by the Ukrainian botanist, Lysenko, and supported by a very able philosophical writer, Prezent, and a body of agriculturists and plant breeders, which was in the main antipathetic to the old school. The new school derived its inspiration from the philosophy of dialectical materialism and the speculative writings of Darwin, Micurin and Burbank, and postulated a system of genetics in which the environment was assigned the chief role in the determination of the hereditary constitution of organisms. According to Lysenko, "Hereditary constitution is, as it were, a concentrate of the environmental conditions assimilated by the plant organisms in a number of preceding generations".

This was in direct contrast to the generally accepted system of genetcis based on Mendel's laws and chromosome theory of heredity, and hence provoked a fierce controversy in Russia which centred mainly round Lysenko representing the new school and Vavilov, the old. After ten years of acute controversy the school of Lysenko appears to have gained the ascendency, and the Mendelian point of view became less popular in Russia.

The genetics controversy in Russia naturally excited world-wide interest among geneticists, but the full facts were not well known outside Russia. This was largely due to the inaccessibility of evidence, which lie scattered in the larger volume of scientific Russian literature,

and the absence of an impartial and critical account of scientific development in that country. There were, however, a few attempts to review the position, but they were often marred by the expression of strong sentiments either for or against the Russian situation.

Dr. Hudson and Dr. Richens have done a great service to the geneticists outside Russia by the publication of this bulletin, which gives a critical and impartial account of the origin and development of the new school in its proper perspective. Purely scientific matters in Russia are so much mixed up with historical, philosophical, political and psychological issues that, without a proper appreciation of such a background, it is not easy to account for the development of unorthodox theories like that of Lysenko. The authors have analysed critically the components of modern Russian genetics and presented a clear picture of the new vocabulary, conceptual system and general outlook of the new school.

The bulletin contains six chapters which deal with the historical background in which the theories of the Russian school were developed, the psychological motives underlying their enunciation, the various tenets of Lysenko's genetic system including his 'nutrient' theory and the experimental and theoretical evidence on which they are based. The last chapter deals with Lysenko's arguments against genetics as ordinarily understood. In dealing with these aspects the authors have drawn attention to the defective methods of experimentation, a logical treatment of scientific subjects and a complete antipathy to the application of statistical methods to quantitative data, which have characterised the Lysenko school. The authors also point out that many of its criticisms of classical genetics are out of date and proceed from an ignorance of the latest advances in the subject outside Russia.

The bulletin concludes with a summary in five languages, *viz.*, English, French, Spanish, German and Russian, and an extensive bibliography of about 300 references.

S. RAMANUJAM.

Rotary Guide to Careers. (Oxford University Press), 1947. As. 8 each.

These are a series of pamphlets issued under the auspices of the Vocational Service Committee of the Bombay Rotary Club and are intended to be guides to the different professions open to youngmen. They are modelled on the pamphlets issued by the Ministry of Labour and National Service in Great Britain, with due regard to conditions and facilities obtaining in India to-day. The information given in these pamphlets includes, advice on the personal and educational qualifications, the opportunities and essential training required, and would, therefore, be most useful to all those who are keen on taking up a professional career.

Pamphlets dealing with (1) Architecture, (2) Banking, (3) Law, (4) Accountancy, (5) Engineering, (6) Civil Engineering, (7) Mechanical Engineering, have already been published. A few more are expected to be published soon. They deal with cotton—raw and Textiles—Civil Aviation and Air Services, Chemical Engineering, Electrical Engineering Librarianship, and Stock, Bullion and Exchange Broking.

The printing and get-up of these pamphlets is very good.

H. N. R.

International Council of Scientific Unions Vol 4. Edited by F. J. M. Stratton. (Cambridge University Press), 1946.

This volume, like the previous ones, is a report of the proceedings of the fourth general assembly of the Council held in London in July 1946. The I.C.S.U. is the successor of the pre-war International Research Council. It is the supreme body in the domain of natural science, and the international bearer of authority of all the national academies of sciences, even as the latter are the most influential organisations in their respective territories. Moreover, the I.C.S.U., according to its name, has all the International scientific unions affiliated to it. Although it is not the dictatorial authority of the several bodies, it is empowered to demand the co-operation of them all in the huge task of symmetrical development of all sciences wholly and solely for the benefit of mankind.

The primary functions of the I.C.S.U. are "to assist at the birh of new international Scientific Unions, to mature the young or weak among the sectional unions and to co-ordinate the activities of the established organisations". The I.C.S.U. performs other important functions as well. It directs international scientific activity in subjects which do not fall within the purview of any existing international association, and calls into existence joint commissions of two or more unions to be active in the intermediate provinces of sciences, like, for instance, oceanography, between the unions of Geodesy, Geophysics and of Biological science, or *Ionosphere*, between physical unions and those of Geodesis and Geophysics.

The criticism that has been directed against the inequitous attention paid by the I.C.S.U. towards that part of the world which is more advanced in science appears to be quite just. The defence of such a policy by the President on the specious plea that the I.C.S.U. forms a "Scientific Church" and not a "Mission" only succeeds in dwarfing the world stature of the organisation, and deprives it of its unique position and opportunity to lead the nations into amity and prosperity by adhering to the most pervasive faith in the world—the religion of the pursuit of truth for its own sake.

K. S. R.

SCIENCE NOTES AND NEWS

Grant for Research in Hyderabad.—The Nizam's Government have sanctioned a non-recurring grant of Rs. 15,00,000 and a recurring annual grant of Rs. 2,76,000 for the Central Laboratories for scientific and industrial research in Hyderabad. -Orders for the equipment required have been placed in the United States of America, and are expected to arrive shortly. The Central Laboratories, besides functioning as the testing and research unit, give technical help and advice to the general public, industrialists, and various Government Departments. They will have their permanent buildings near the Osmania University, and 56 acres of land have been acquired for this purpose.

New Comet Seen.—The discovery of a new comet—visible with the aid of a moderate telescope—was reported to the Harvard University Observatory.

The comet is in the 12th magnitude and was sighted on July 18 and July 23 and Mr. C. A. Wirtanen at Lick Observatory, San Jose, California. Comets, generally, are not visible without the aid of a telescope beyond the sixth magnitude.

Mr. Wirtanen described the new comet as "diffused with its central nucleus" the constellation Wauarius. He believed it would be visible for some weeks.

The Indian Mathematical Society.—The 15th Biennial Conference of the Society will be held at Waltair, Madras Presidency, under the auspices of the Andhra University, from 22nd to 24th December 1947.

Members wishing to read papers at the Conference are requested to send their papers along with a short summary to Prof. A. Narasinga Rao, Department of Mathematical Physics, Andhra University, Waltair, so as to reach him on or before 15th October 1947.

Prize Problem in Mathematics. The Indian Mathematical Society has proposed the following problems for the *Narasinga Rao Medal—Mathematical Research in* 1948.

To make a contribution to the theory of plane projective geometries, particularly the following types of non-desarguesian geometries:

(1) The geometries where a single (p, L) Desargues' Theorem holds where L is a line passing through the point *p*. [The (p, L) Desargues' Theorem states that if the three joins of the corresponding vertices of 2 triangles concur at *p*, and if two pairs of their corresponding sides intersect on L, then the third pair also intersect on L].

(2) The geometries in which there is a transitive group of translations.

(3) The geometries in which the theorem of the complete quadrangle (that is, existence of a unique harmonic conjugate C' of C with respect to AB for every triad of collinear points) holds.

(4) The required "contribution" is to bear on the following questions :—

(i) The distribution of points *p* and lines L passing through *p*, such that the (*p*,L) Desargues' Theorem is true, the distribution of collinear triads of points A, B, C, such that C has a unique harmonic conjugate with respect to AB.

(ii) The distribution of quadrangles with three collinear diagonal points.

(iii) The projective group of the plane and the projective groups of its straight lines.

The solutions of the prize problem are to be sent to the President of the Society at the time, and the last date for the submission of the theses is the 1st July 1948.

For further particulars and references to literature on the problems of research apply to :—Dr. A. Narasinga Rao, Editor, *The Mathematics Student*, Andhra University, Waltair.

All-India Board of Technical Studies.—With a view to attaining uniform standards in Engineering Education, the All-India Board of Technical Studies in Engineering and Metallurgy have instituted in the first instance Diploma and Certificate courses in Electrical Engineering.

The All-India Diploma course is a full-time three-year course in an affiliated Institution followed by one year of practical training. The Diploma has been provisionally recognised by the Federal Public Service Commission for admission to examinations held by them for recruitment to certain posts under the Government of India.

The All-India Certificate course is a part-time course of three years' duration. Persons employed in workshops and industry are eligible for this course which enables them to acquire further knowledge in subjects relating to their profession.

National Institute of Sciences.—At a meeting of the Council of the National Institute of Sciences of India and the Fellows of the Institute held in Bombay on the first of August, Pandit Jawaharlal Nehru was elected Fellow of the Institute.

The meeting assured Pandit Nehru of their full support in the tasks of raising the lot of the people and the scientific development of India and expressed the hope that they could count on his active participation in the activities of the Institute.

Central Medical Institute.—India will have a unique organisation in the Central Medical Institute to be established at the cost of five crores of rupees.

Blueprints for the Institute, first suggested by the Bhore Committee, have been worked out in a report prepared by a Committee presided over by Sir A. Lakshmanaswami Mudaliar. The Institute, which is to be located in Delhi, will be primarily an advance research and training centre. The model adopted is that of

the famous Johns Hopkins Medical College in U.S.A.

The Institute will be built over a period of ten years at a capital cost of five crores of rupees, and an annual recurring expenditure of Rs. 56 lakhs will be incurred. It will have a 1,000-bed hospital attached to it. The Government of India are considering the report.

Food Technology.—The Rice Technology Committee has recommended the use of parboiled rice in place of raw rice as the former gives a higher yield of the whole unbroken rice, has more nutritive value and has better keeping qualities than raw rice. In view of the world shortage of rice a greater out-turn of whole parboiled rice should be of great significance in India's rice economy. The Committee also recommended the standardization of the parboiling process in India.

The Food Processing Committee has recommended further research on the processing of seed-cakes and the pilot plant production of soya-bean milk.

Adhesive for Plywood Industry.—The Forest Research Institute, Dehra Dun, has taken out a patent for the manufacture of prolamin adhesive which is extracted from gluten, a by-product of starch factories. This adhesive is of unique importance to the Indian Plywood Industry, and in spite of its low cost approaches phenolformaldehyde synthetic resin in efficiency.

Aluminium Production in C.P.—It is officially stated that the Provincial Government has decided to establish a factory for the production of aluminium in C.P. Of the raw materials required, bauxite of suitable quality is available in plenty.

This province has enough coal resources, and electricity can be generated at an economic rate. The establishment of this industry, it is stated, will result in the setting up of rolling mills and fabrication units and in the manufacture of titanium and aluminium powder pigments.

Chemical industries as sulphuric acid, required also for super-phosphate manufacture and caustic soda, will follow as a natural corollary.

Expedition to Tongaland.—Tongaland in Zululand, near the Portuguese border, is a storehouse of immense value to the scientist. It is through this very inaccessibility, however, that so little is known of the territory or its potentialities.

A representative body of scientists will carry out a geographical, zoological and botanical investigation to determine its potentialities for field studies and for scientific research and education. The expedition will also investigate the area's suitability as a nature reserve and the best way of opening it for visitors.

From a scientific point of view great importance attaches to the extensive fossil beds in the Ndumu area. This area is best known for its ammonites (fossilised molluscs with distinct tentacled heads). Of outstanding interest to scientists also is the investigation which will be made to determine, if time permits, the area in Northern Zululand where tropical flora and fauna integrate with the sub-tropical.

It is well known to scientists that many forms of tropical flora and fauna disappear in the vicinity of Hluhluwe Reserve. The best known example of this is the tsetse fly, whose depredations, so widespread in tropical Africa, in the Hluhluwe and Unfolosi area, disappear.

Experiments with Foreign Paddy.—An imported variety of Chinese paddy cultivated in Kashmir, is reported by the I.C.A.R. to yield twice as much as the local varieties. While this does not need artificial manure, the soil fertility is to be maintained with green and farmyard manure.

Of the other types of paddy imported into India some years ago, the Russian variety has been harvested about six weeks earlier than the indigenous kind. There are great possibilities of this rice being grown on high altitudes between 7,000 and 9,000 ft.

GEOMAGN ETICACTIVITY

Geomagnetic activity during the quarter April-June 1947 was very much on the decrease as compared with the previous quarter. Some details of the geomagnetic disturbances recorded at the Alibag Magnetic Observatory during the quarter April-June 1947 are given in the following table in which t_0, t represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively, and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k-index recorded during the disturbances have also been given.

Date	t_0	t	T	Range			k_m	Nature of commencement
				D	H	V		
1947—	H. M.	H. M.	Hrs.	Min.	γ	γ		
April 17-18 ..	17 54	01 08 on 18th	3½	9·8	429	103	8	Sudden
May 24	07 42	12 15	3	4·9	225	51	7	Sudden
June 5	12 56	12 56	2	4·9	198	51	6	Sudden
June 13-14 ..	23 20	08 30 on 14th	7	9·3	143	86	6	Sudden

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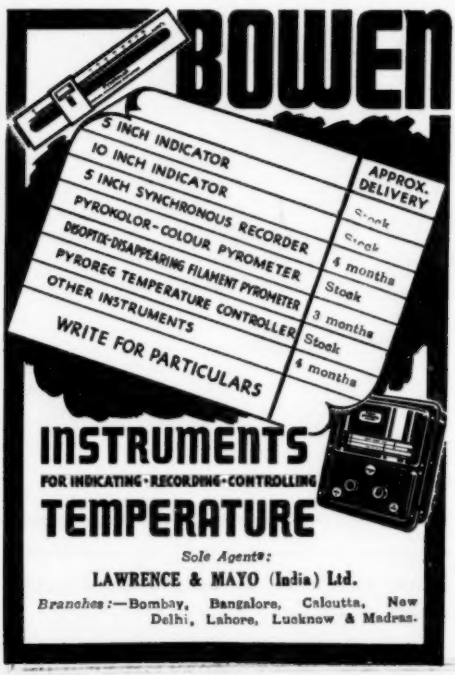

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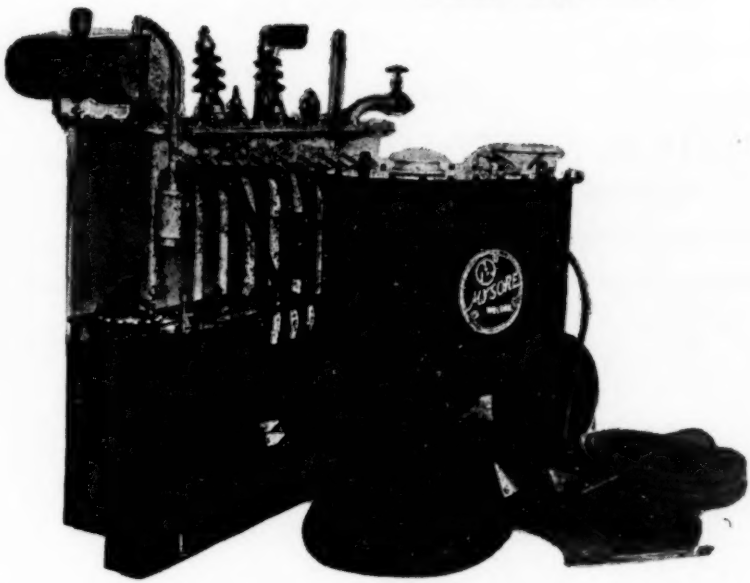

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English	2/10	4/8	5/14	9/8	14/8	23	38/8

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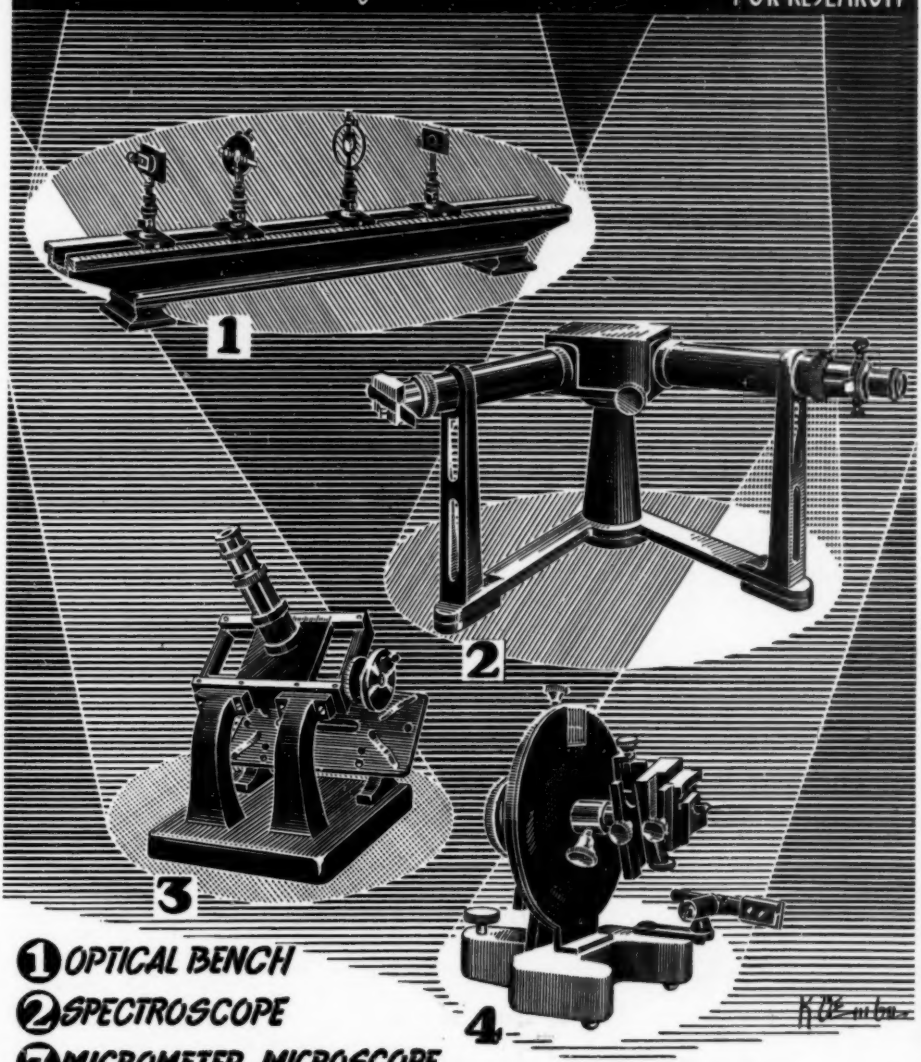

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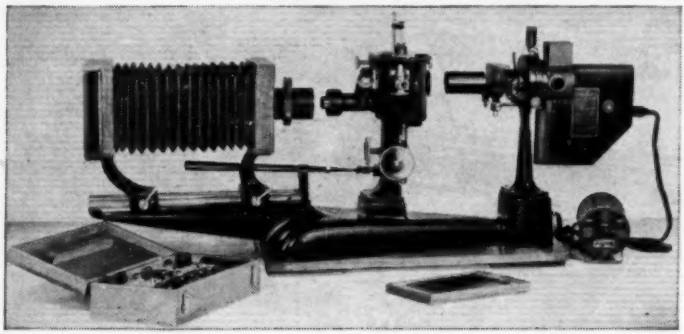

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